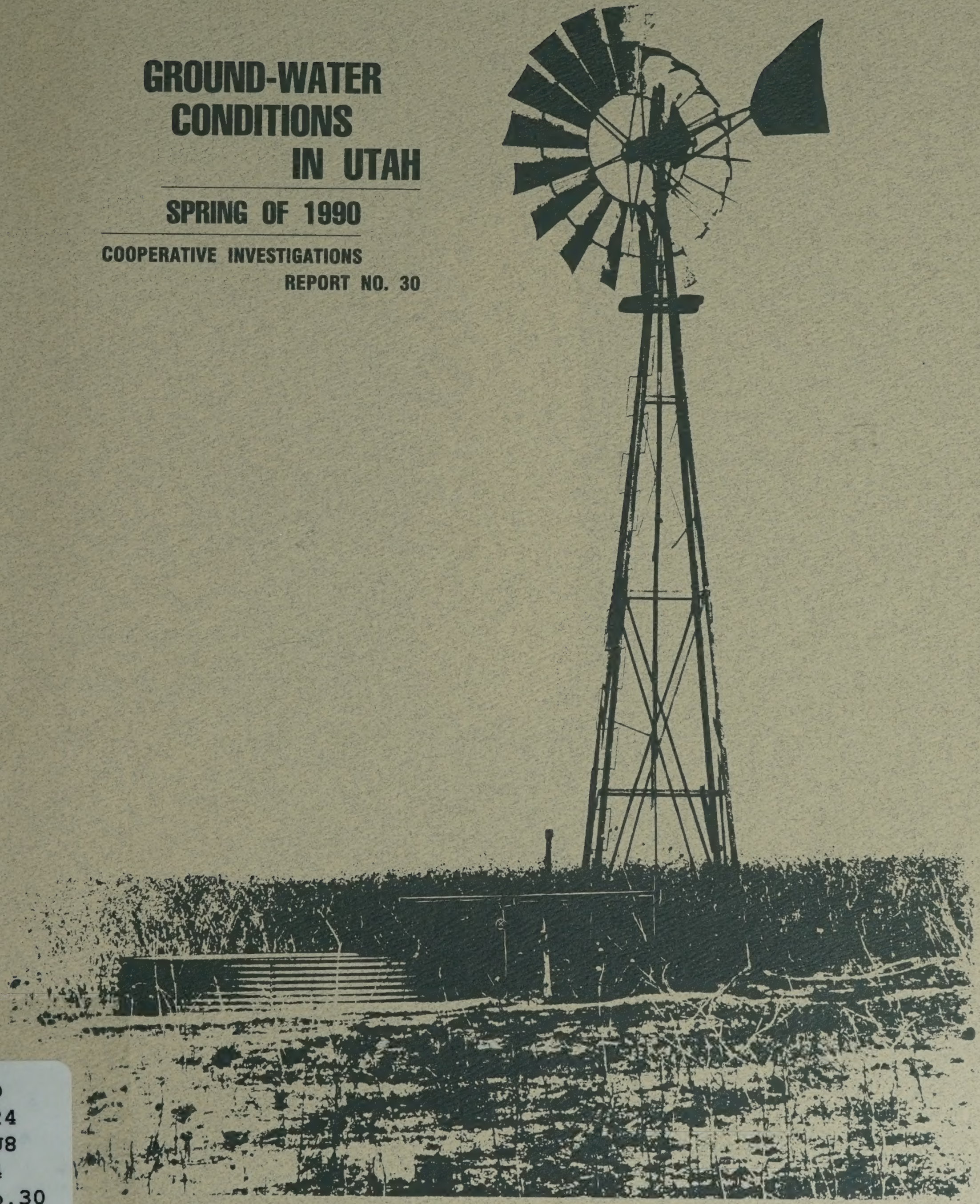
GROUND-WATER CONDITIONS IN UTAH

SPRING OF 1990

COOPERATIVE INVESTIGATIONS
REPORT NO. 30



UTAH DIVISION OF WATER RESOURCES • UTAH DIVISION OF WATER RIGHTS • U.S. GEOLOGICAL SURVEY

GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1990

by

L.R. Herbert and others

United States Geological Survey

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CONTENTS

	Page
Introduction	1
Utah's ground-water reservoirs	3
Summary of conditions	3
Major areas of ground-water development	9
Curlew Valley by G.J. Smith	9
Cache Valley by Kim A. Kariya	12
East Shore area by James P. Eads	15
Salt Lake Valley by D.V. Allen	19
Tooele Valley by Bert Stolp	25
Utah and Goshen Valleys by Lynette E. Brooks	29
Juab Valley by R. B. Garrett	36
Sevier Desert by R. B. Garrett	39
Upper and central Sevier Valleys and upper Fremont River valley by W.C. Brothers and R.W Puchta	44
Pahvant Valley by R.L. Swenson	49
Cedar Valley, Iron County by D.C. Emett	55
Parowan Valley by W.R. Overman	58
Escalante Valley	
Milford area by R.L. Swenson	61
Beryl-Enterprise area by G.W. Sandberg	64
Central Virgin River area by G.W. Sandberg	69
Other areas by L.R. Herbert	73
References	84

ILLUSTRATIONS

			Page
Figure	1.	Map showing areas of ground-water development specifically referred to in this report	4
	2.	Map of Curlew Valley showing change of water levels from March 1989 to March 1990	10
	3.	Graphs showing relation of water levels in selected wells in Curlew Valley to cumulative departure from the average annual precipitation at Snowville and to annual withdrawals from wells	11
	4.	Map of Cache Valley showing change of water levels from March 1989 to March 1990	13
	5.	Graphs showing relation of water levels in well (A-12-1)29cab-1 in Cache Valley to discharge of the Logan River near Logan, to cumulative departure from the average annual precipitation at Logan, Utah State University, and to annual withdrawals from wells	14
	6.	Map of the East Shore area showing change of water levels from March 1989 to March 1990	16
	7.	Graphs showing relation of water levels in selected wells in the East Shore area to cumulative departure from the average annual precipitation at Ogden Pioneer Powerhouse and to annual withdrawals from wells	17
	8.	Map of the Salt Lake Valley showing change of water levels in the principal aquifer from February 1989 to February 1990	20
	9.	Graphs showing estimated population of Salt Lake County, total annual withdrawals from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City WSO (International Airport)	21
	10.	Graphs showing relation of water levels and chloride concentration in water from selected wells in the principal aquifer in Salt Lake Valley to cumulative departure from the average annual precipitation at Silver Lake Brighton	22
	11.	Graphs showing water levels in selected wells in the shallow unconfined aquifer in Salt Lake Valley	24
	12.	Map of Tooele Valley showing change of water levels in artesian aquifers from March 1989 to March 1990	26
	13.	Graphs showing relation of water levels in selected wells in Tooele Valley to cumulative departure from the average annual precipitation at Tooele and to annual withdrawals from wells	27
	14.	Map of Utah and Goshen Valleys showing change of water levels in the water-table aquifers from March 1989 to March 1990	30
	15.	Map of Utah Valley showing change of water levels in the shallow artesian aquifer in deposits of Pleistocene age from March 1989 to March 1990	31
	16.	Map of Utah Valley showing change of water levels in the deep artesian aquifer in deposits of Pleistocene age from March 1989 to March 1990	32
	17.	Map of Utah Valley showing change of water levels in the artesian aquifer in deposits of Quaternary or Tertiary age from March 1989 to March 1990	33

		Page
Figure 18.	Graphs showing relation of water levels in selected wells to cumulative departure from the average annual precipitation at Alpine and Spanish Fork Powerhouse, and to total annual withdrawals from wells and annual withdrawals for public supply in Utah and Goshen Valleys	34
19.	Map of Juab Valley showing change of water levels from March 1989 to March 1990	37
20.	Graphs showing relation of water levels in selected wells in Juab Valley to cumulative departure from the average annual precipitation at Nephi and to annual withdrawals from wells	38
21.	Map of part of the Sevier Desert showing change of water levels in the shallow artesian aquifer from March 1989 to March 1990	40
22.	Map of part of the Sevier Desert showing change of water levels in the deep artesian aquifer from March 1989 to March 1990	41
23.	Graphs showing relation of water levels in selected wells in the Sevier Desert to discharge of the Sevier River near Juab, to cumulative departure from the average annual precipitation at Oak City, and to annual withdrawals from wells	42
24.	Map of the upper Sevier Valley and the upper Fremont River valley showing change of water levels in selected wells from March 1989 to March 1990	45
25.	Map of the central Sevier Valley showing change of water levels from March 1989 to March 1990	46
26.	Graphs showing relation of water levels in selected wells to discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at selected climate stations, and to annual withdrawal from wells--upper and central Sevier Valleys and upper Fremont River valley	47
27.	Map of Pahvant Valley showing change of water levels from March 1989 to March 1990	50
28.	Graphs showing relation of water levels in selected wells in Pahvant Valley to cumulative departure from the average annual precipitation at Fillmore and to annual withdrawals from wells	51
29.	Concentrations of dissolved solids in water from selected wells in Pahvant Valley	54
30.	Map of Cedar Valley, Iron County, showing change of water levels from March 1989 to March 1990	56
31.	Graphs showing relation of water levels in well (C-35-11)33aac-1 in Cedar Valley, Iron County, to cumulative departure from the average annual precipitation at the Cedar City FAA Airport, to discharge of Coal Creek near Cedar City, and to annual withdrawals from wells	57

			Page
Figure	32.	Map of Parowan Valley showing change of water levels from March 1989 to March 1990	59
	33.	Graphs showing relation of water levels in well (C-34-8)5bca-1 in Parowan Valley to cumulative departure from the average annual precipitation at Parowan Power Plant and to annual withdrawals from wells	60
	34.	Map of the Milford area showing change of water levels from March 1989 to March 1990	62
	35.	Graphs showing relation of water levels in wells (C-29-10)6ddc-1 and (C-29-11)13add-1 in the Milford area to cumulative departure from the average annual precipitation at Milford Airport, to discharge of the Beaver River at Rocky Ford Dam, and to annual withdrawals from wells	63
	36.	Map of the Beryl-Enterprise area showing change of water levels from March 1989 to March 1990	65
	37.	Map of the Beryl-Enterprise area showing change of water levels from March 1985 to March 1990	66
	38.	Map of Beryl-Enterprise area showing water-level contours, March 1990	67
	39.	Graphs showing relation of water levels in wells (C-35-17)25cdd-1 and (C-35-17)25dcd-1 in the Beryl-Enterprise area to cumulative departure from the average annual precipitation at Modena, to annual withdrawals from wells, and to concentration of dissolved solids in well (C-34-16)28dcc-2	68
	40.	Map of the central Virgin River area showing change of water levels from February 1989 to February 1990	70
	41.	Graphs showing relation of water levels in selected wells to discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, and to annual withdrawals from wells in the central Virgin River area	71
	42.	Map of Cedar Valley, Utah County, showing change of water levels from March 1989 to March 1990	74
	43.	Map of Sanpete Valley showing change of water levels from March 1989 to March 1990	75
	44.	Graphs showing relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas	76

TABLES

Table	1.	Areas of ground-water development in Utah specifically referred to in this report	5
	2.	Number of wells constructed and withdrawal of water from wells in Utah	7
	3.	Total annual withdrawal of water from wells in major areas of ground-water development in Utah, 1979-88	8

CONVERSION FACTORS

Most values in this report are given in inch-pound units. Conversion factors to metric units are shown below.

Multiply	by	To obtain
Acre-foot	1233	Cubic meter
Foot	0.3048	Meter
Inch	25.40	Millimeter
Mile	1.609	Kilometer

Chemical concentration is given only in metric units-milligrams per liter. For concentrations less than 7,000 milligrams per liter, the numerical value is about the same as for concentrations in parts per million.

GROUND-WATER CONDITIONS IN UTAH, SPRING OF 1990

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L.R. Herbert and others
U.S. Geological Survey

INTRODUCTION

This is the twenty-seventh in a series of annual reports that describe ground-water conditions in Utah. Reports in the series, published cooperatively by the U.S. Geological Survey and the Utah Division of Water Resources, provide data to enable interested parties to keep abreast of changing ground-water conditions.

This report, like the others in the series, contains information on well construction, ground-water withdrawals from wells, water-level changes, and related changes in precipitation and streamflow. Supplementary data such as graphs showing chemical quality of water and maps showing water-level contours are included in reports of this series only for those years or areas for which applicable data are available and are important to a discussion of changing ground-water conditions.

The report includes individual discussions of selected major areas of ground-water development in the State for the calendar year 1989. Water-level fluctuations, however, are described for the period from the spring of 1989 to the spring of 1990. Much of the data used in the report were collected by the Geological Survey in cooperation with the Division of Water Rights, Utah Department of Natural Resources.

The following reports dealing with ground water in the State were released as Open-File reports, printed by the U.S. Geological Survey, printed by cooperating agencies, or published in conference proceedings during 1989:

Ground-water conditions in Utah, spring of 1989, Carole B. Burden and others, Utah Division of Water Resources Cooperative Investigations Report 29.

The relation of geohydrologic setting to the potential for ground-water contamination in Utah, J.S. Gates, and G.W. Freethey, 1989, in Cordy, G.E., ed., Geology and hydrology of hazardous-waste, mining-waste, waste-water, and repository sites in Utah: Utah Geological Association Publication 17, p. 11-28.

U.S. Geological Survey ground-water studies in Utah, J.S. Gates, 1988, U.S. Geological Survey Open-File Report 88-157.

Seepage study of the South Bend, Richfield, and Vermillion Canals, Sevier County, Utah, L.R. Herbert and G.J. Smith, 1989, Utah Department of Natural Resources Technical Publication 97.

Continuous seismic-reflection survey of the Great Salt Lake, Utah--East of Antelope and Fremont Islands, P.M. Lambert and J.C. West, 1989, U.S. Geological Survey Water-Resources Investigations Report 88-4157.

Hydrology of the Prospector Square area, Summit County, Utah, J.L. Mason, 1989, U.S. Geological Survey Water-Resources Investigations Report 88-4156.

Geohydrology and water quality in the vicinity of the Silver Creek tailings, Summit County, Utah, J.L., Mason, 1989, in Cordy, G.E., ed., Geology and hydrology of hazardous-waste, mining-waste, waste-water, and repository sites in Utah: Utah Geological Association Publication 17, p. 135-148.

Hydrologic evaluation and water-supply considerations for five Paiute Indian land parcels, Millard, Sevier, and Iron Counties, southwestern Utah, Don Price, D.W. Stephens, and L.S. Conroy, 1989, U.S. Geological Survey Water-Resources Investigations Report 89-4010.

Selenium contamination from irrigation drainage in the western United States with emphasis on Utah, D.W. Stephens and Bruce Waddell, 1989, in Cordy, G.E., ed., Geology and hydrology of hazardous-waste, mining-waste, wastewater, and repository sites in Utah: Utah Geological Association Publication 17, p. 165-182.

Selenium and wildlife areas in Utah, D.W. Stephens, 1989, Proceedings, Second National Symposium on Water Quality, Orlando, Florida, November 1989.

Simulation analysis of the ground-water system in Mesozoic rocks in the Four Corners area, Utah, Colorado, Arizona, and New Mexico, B.E. Thomas, 1989, U.S. Geological Survey Water-Resources Investigations Report 88-4086.

UTAH'S GROUND-WATER RESERVOIRS

Small quantities of ground water can be obtained from wells throughout much of Utah, but large supplies that are of suitable chemical quality for irrigation, public supply, or industrial use generally can be obtained only in specific areas. The major areas of ground-water development discussed in this report are shown in figure 1 and named in table 1. Relatively few wells outside of these areas yield large supplies of water of good chemical quality for the uses listed above, although some of the basins in western Utah and many areas in eastern Utah have not been explored sufficiently to determine their potential for ground-water development.

About 2 percent of the wells in Utah obtain water from consolidated rocks. The consolidated rocks that yield the most water are lava flows, such as basalt, which contain interconnected vesicular openings, fractures, or permeable weathered zones at the tops of flows; limestone, which contains fractures or other openings enlarged by solution; and sandstone, which contains open fractures. Most of the wells that tap consolidated rocks are in the eastern and southern parts of the State in areas where water supplies cannot be obtained readily from unconsolidated deposits.

About 98 percent of the wells in Utah draw water from unconsolidated deposits. These deposits may consist of boulders, gravel, sand, silt, or clay, or a mixture of some or all of these materials. Wells obtain the largest yields from the coarser materials that are sorted into deposits of uniform grain size. Most wells that tap unconsolidated deposits are in large intermountain basins, which have been partly filled with rock material eroded from the adjacent mountains.

SUMMARY OF CONDITIONS

The estimated total withdrawal of water from wells in Utah during 1989 was about 851,000 acre-feet, which is about 30,000 acre-feet more than the estimate for 1988 and about 107,000 acre-feet more than the average annual withdrawal for 1979-88 (table 2). The increase in withdrawal was predominantly for irrigation, which was about 504,000 acre-feet in 1989 (table 2), an increase of 62,000 acre-feet from 1988. Withdrawal for public supply was about 230,000 acre-feet, which is 1,000 acre-feet less than the estimate for 1988. Withdrawal for industrial use was about 52,000 acre-feet, which is about 27,000 acre-feet less than the 1988 estimate.

Of the 16 areas of major ground-water development referred to in this report (table 2), only five areas, Curlew Valley, Cache Valley, the East Shore area, Salt Lake Valley, and the Beryl-Enterprise area, had decreases in ground-water withdrawals in 1989. Withdrawals in 12 of the 16 areas exceeded the 1979-88 annual average for each area (table 2).

The quantity of water withdrawn from wells is related to demand and availability of water from other sources, which in turn are partly related to local climatic conditions. Calendar year 1988 was the first year of generally less-than-average precipitation in Utah after six years of greater-than-average precipitation. This trend of less-than-average precipitation continued in 1989. Of the 33 weather stations throughout Utah for which average annual precipitation values and graphs of cumulative departure from average annual precipitation are included in this report, 32 stations recorded precipitation in 1989 that was less than the average annual value. The largest negative departure from average precipitation was 8.15 inches, recorded at Ogden Pioneer Power House near Ogden. Only one of the 33 weather stations, Callao, recorded greater-than-average precipitation in 1989, with a positive departure of 0.08 inches.

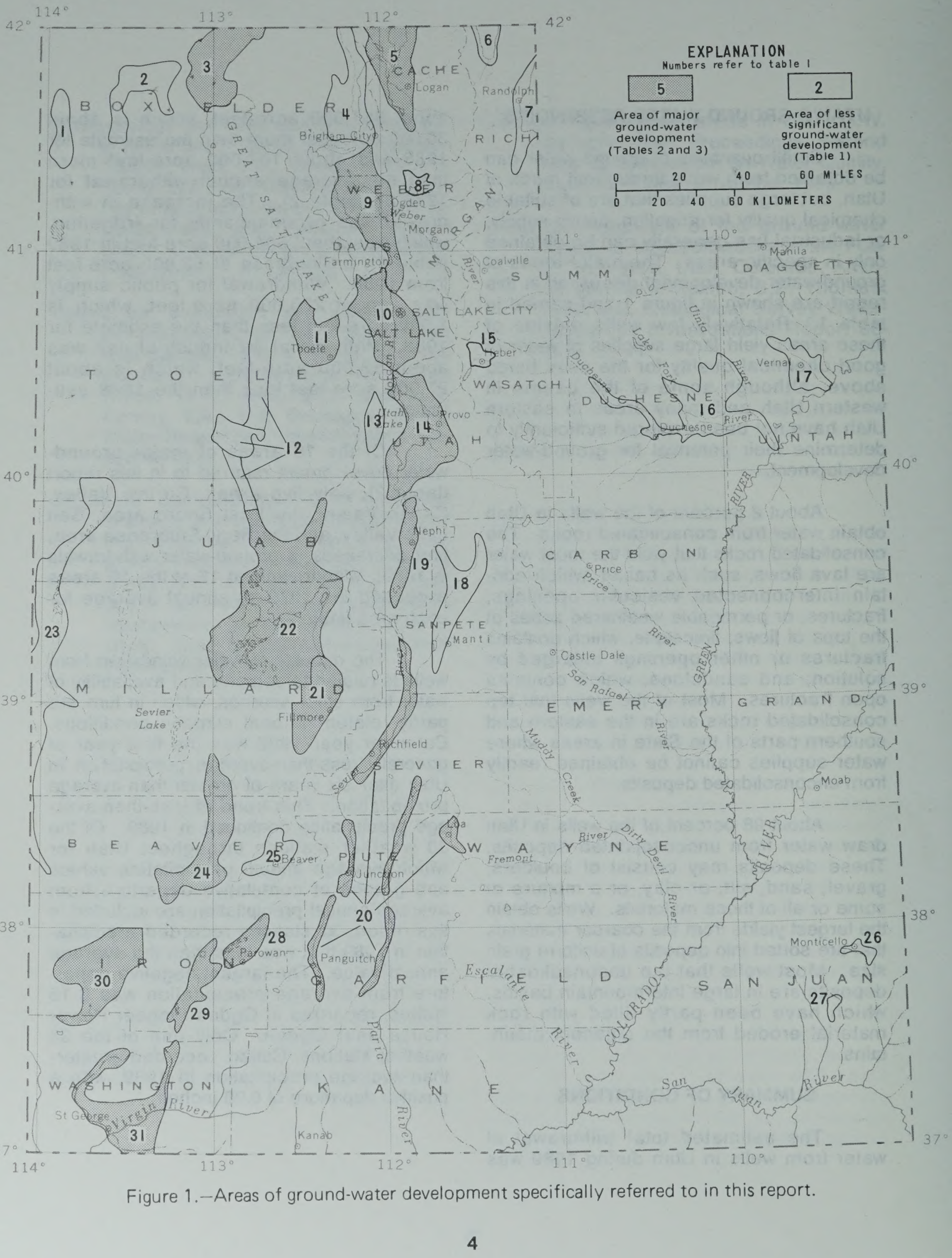


Figure 1.—Areas of ground-water development specifically referred to in this report.

Table 1.--Areas of ground-water development in Utah specifically referred to in this report

Number in figure 1	Area	Principal type of water-bearing rocks
1	Grouse Creek Valley	Unconsolidated
2	Park Valley	Do.
3	Curlew Valley	Unconsolidated and consolidated
4	Malad-lower Bear River valley	Unconsolidated
5	Cache Valley	Do.
6	Bear Lake valley	Do.
7	Upper Bear River valley	Do.
8	Ogden Valley	Do.
9	East Shore area	Do.
10	Salt Lake Valley	Do.
11	Tooele Valley	Do.
12	Dugway area	Do.
	Skull Valley	Do.
	Old River Bed	Do.
13	Cedar Valley, Utah County	Do.
14	Utah and Goshen Valleys	Do.
15	Heber Valley	Do.
16	Duchesne River area	Unconsolidated and consolidated
17	Vernal area	Do.
18	Sanpete Valley	Do.
19	Juab Valley	Unconsolidated
20	Central Sevier Valley	Do.
	Upper Sevier Valleys	Do.
	Upper Fremont River valley	Unconsolidated and consolidated
21	Pahvant Valley	Do.
22	Sevier Desert	Unconsolidated
23	Snake Valley	Do.
24	Milford area	Do.
25	Beaver Valley	Do.
26	Monticello area	Consolidated
27	Blanding area	Do.
28	Parowan Valley	Unconsolidated and consolidated
29	Cedar Valley, Iron County	Unconsolidated
30	Beryl-Enterprise area	Do.
31	Central Virgin River area	Unconsolidated and consolidated

The less-than-average precipitation in most parts of the State during 1989 resulted in less-than-average recharge to the ground-water reservoirs. Less-than-average precipitation probably resulted in less-than-average streamflow and less available surface water for irrigation. Less precipitation and surface water for irrigation resulted in increased ground-water withdrawals for irrigation, which along with continued large withdrawals for public supply, resulted in declines in ground-water levels in most parts of the State from the spring of 1989 to the spring of 1990. No water-level rises were measured in Juab Valley, upper Sevier Valley and upper Fremont River valley, Parowan Valley, the Beryl-Enterprise area, and in the artesian aquifers in deposits of Quaternary or Tertiary age in Utah Valley. Water levels rose in parts of the other 11 major areas of ground-water development, probably because of effects of local recharge from irrigation and local decreases in withdrawals for public supply and industrial uses.

The total number of wells drilled during 1989 (table 2), taken from reports by well drillers filed with the Utah Division of Water Rights, was about 26 percent more than the number reported for 1988. Of the 627 wells drilled in 1989, 341 were for new appropriations of ground water and 54 were replacement wells. The remaining 232 wells include test and monitoring wells. Thirty-five large-diameter wells (12 inches or more), mostly for withdrawal of water for public supply, irrigation, and industrial use, were drilled in 1989.

The areas of ground-water development specifically referred to in this report are shown in figure 1. Information about the number of wells constructed and withdrawal of water from wells in Utah is presented in table 2. Total annual withdrawals from wells in major areas of ground-water development in Utah for 1979-88 are shown in table 3.

Table 2.--**Number of wells constructed and withdrawal of water from wells in Utah**

Number of wells constructed in 1989.--Data provided by Utah Department of Natural Resources, Division of Water Rights. Includes test wells and replacement wells.

Diameter of 12 inches or more.--Constructed for irrigation, industry, or public supply.

Estimated withdrawals from wells.--

1988 total: From Burden and others (1989, table 2), as revised.

1979-88 average annual: Calculated from previous reports of this series and also includes some previously unpublished revisions.

Area	Number in figure 1	Number of wells constructed in 1989: Total	Number of wells constructed in 1989: Diameter of 12 inches or more	Estimated withdrawals from wells (acre-feet), 1989: Irrigation	1989: Industry	1989: Public supply	1989: Domestic and stock	1989: Total (rounded)	1988 total	1979-88 average annual
Curlew Valley	3	0	0	29,300	0	50	50	29,000	34,000	28,000
Cache Valley	5	34	1	13,300	1,400	6,900	1,900	24,000	33,000	26,000
East Shore area	9	94	3	(1)19,500	7,700	29,000	4,800	61,000	68,000	52,000
Salt Lake Valley	10	107	9	3,500	(2)11,800	92,700	25,300	133,000	141,000	118,000
Tooele Valley	11	16	1	(1)21,600	1,100	4,400	300	27,000	26,000	25,000
Utah and Goshen Valleys	14	61	0	49,600	6,400	44,500	21,000	121,000	113,000	(3)92,000
Juab Valley	19	1	0	25,900	0	(4)1,400	300	28,000	22,000	15,000
Sevier Desert	22	1	0	12,500	2,300	1,600	300	17,000	15,000	16,000
Upper and central Sevier Valleys and upper Fremont River valley	20	33	0	17,500	100	1,250	3,200	22,000	21,000	23,000
Pahvant Valley	21	2	1	81,000	100	470	300	82,000	71,000	(3)66,000
Cedar Valley, Iron County	29	11	1	23,900	500	3,200	900	28,000	20,000	24,000
Parowan Valley	28	5	2	(5)27,000	300	1,300	200	29,000	20,000	24,000
Escalante Valley										
Milford area	24	4	1	38,500	(6)6,000	770	250	46,000	40,000	48,000
Beryl-Enterprise area	30	16	8	83,800	0	410	750	85,000	88,000	90,000
Central Virgin River area	31	3	0	6,800	1,100	15,000	250	23,000	18,000	20,000
Other areas (7)		239	8	50,600	13,700	26,800	5,200	96,000	91,000	77,000
Totals (rounded)		(8)627	35	504,000	52,000	230,000	65,000	851,000	821,000	(3)744,000

(1) Includes some domestic and stock use.
(2) Includes some use for air conditioning, about 30 percent of which is reinjected into the aquifer.
(3) Previously unreported revision.
(4) Includes some industrial use.
(5) Includes some use for stock.
(6) Withdrawal for geothermal power generation. Approximately 5,500 acre-feet was reinjected.
(7) Withdrawals are estimated minimum. See page 72 for withdrawal estimates for other areas.
(8) Includes 341 wells drilled for new appropriations of ground water and 54 replacement wells. Data from Division of Water Rights, Utah Department of Natural Resources.

Table 3.--Total annual withdrawal of water from wells in major areas of ground-water development in Utah, 1979-88
[From previous reports of this series.]

Area	Number in figure 1	Thousands of acre-feet										
		1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1979-88 average (rounded)
Curlew Valley	3	29	30	40	26	18	20	27	26	29	34	28
Cache Valley	5	28	25	33	26	20	21	22	23	26	33	26
East Shore area	9	46	45	36	38	43	49	67	66	67	68	52
Salt Lake Valley	10	125	129	127	115	110	102	110	104	122	141	118
Tooele Valley	11	30	27	30	26	22	23	22	21	22	26	25
Utah and Goshen Valleys	14	107	94	101	86	74	78	88	75	(1)104	113	(1)92
Juab Valley	19	21	15	21	16	6	6	11	10	22	22	15
Sevier Desert	22	45	13	18	16	8	10	13	11	15	15	16
Upper and central Sevier Valleys and upper Fremont River valley	20	24	24	25	28	21	20	21	22	22	21	23
Pahvant Valley	21	(1)85	(1)77	(1)83	(1)70	42	42	(1)62	60	66	71	(1)66
Cedar Valley, Iron County	29	32	28	29	28	21	20	23	19	21	20	24
Parowan Valley	28	30	28	27	25	22	22	25	24	22	20	24
Escalante Valley												
Milford area	24	49	61	69	55	39	32	49	46	44	40	48
Beryl-Enterprise area	30	79	71	93	99	86	95	100	93	97	88	90
Central Virgin River area(2)	31	20	20	22	27	16	19	21	20	20	18	20
Other areas		92	70	83	100	52	64	77	68	75	91	77
Totals		(1)842	(1)757	(1)837	(1)781	600	623	(1)738	688	(1)774	821	(1)744

(1) Previously unpublished revision

(2) Prior to 1984 included under 'Other Areas'

MAJOR AREAS OF GROUND-WATER DEVELOPMENT

CURLEW VALLEY

by G.J. Smith

Withdrawal of water from wells in Curlew Valley in 1989 was approximately 29,000 acre-feet, a decrease of 5,000 acre-feet from the amount reported for 1988 and 1,000 acre-feet more than the average annual withdrawal for 1979-88 (table 2).

Water levels in Curlew Valley generally declined from March 1989 to March 1990 as a result of less-than-normal recharge from less-than-average precipitation and local increases in ground-water withdrawals. In local areas in the northern and western parts of the valley water levels rose slightly (fig. 2). The water-level rises were probably the result of local decreases in ground-water withdrawals.

The relation of water levels in two selected observation wells to cumulative departure from average annual precipitation at Snowville and to annual withdrawals from wells is shown in figure 3. Precipitation at Snowville in 1989 was 6.98 inches, which is 5.40 inches less than the average annual precipitation for 1941 through 1989. The hydrographs for wells (B-14-9)7bbb-1 in the irrigated area near Snowville and (B-12-11)16cdc-1 near the irrigated area of Kelton are representative of ground water levels in those areas. The effects of precipitation and withdrawals for irrigation are reflected in these wells. The 1989 withdrawal from wells was 7,800 acre-feet more than the 1963-89 annual average (fig. 3).

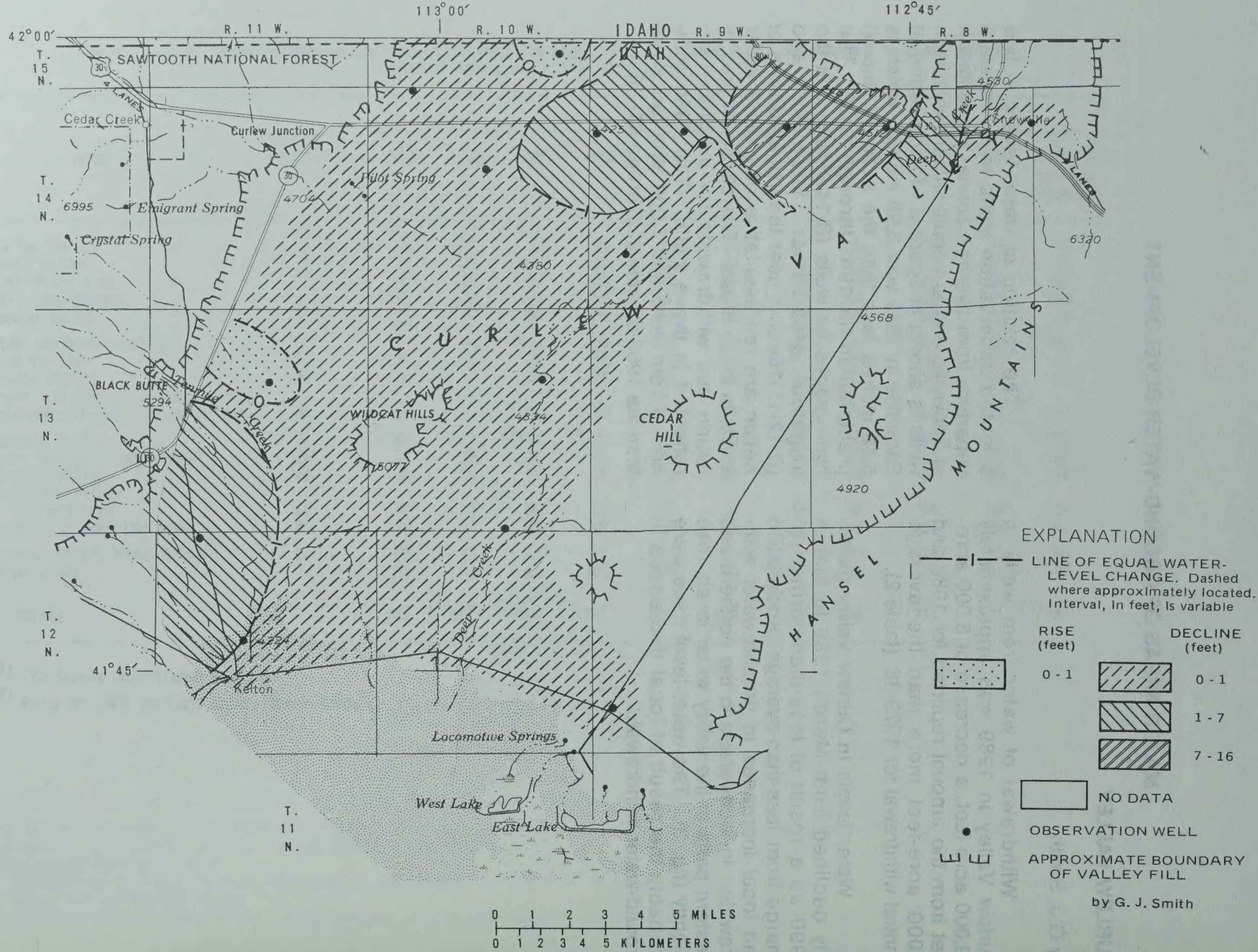


Figure 2.--Map of Curlew Valley showing change of water levels from March 1989 to March 1990.

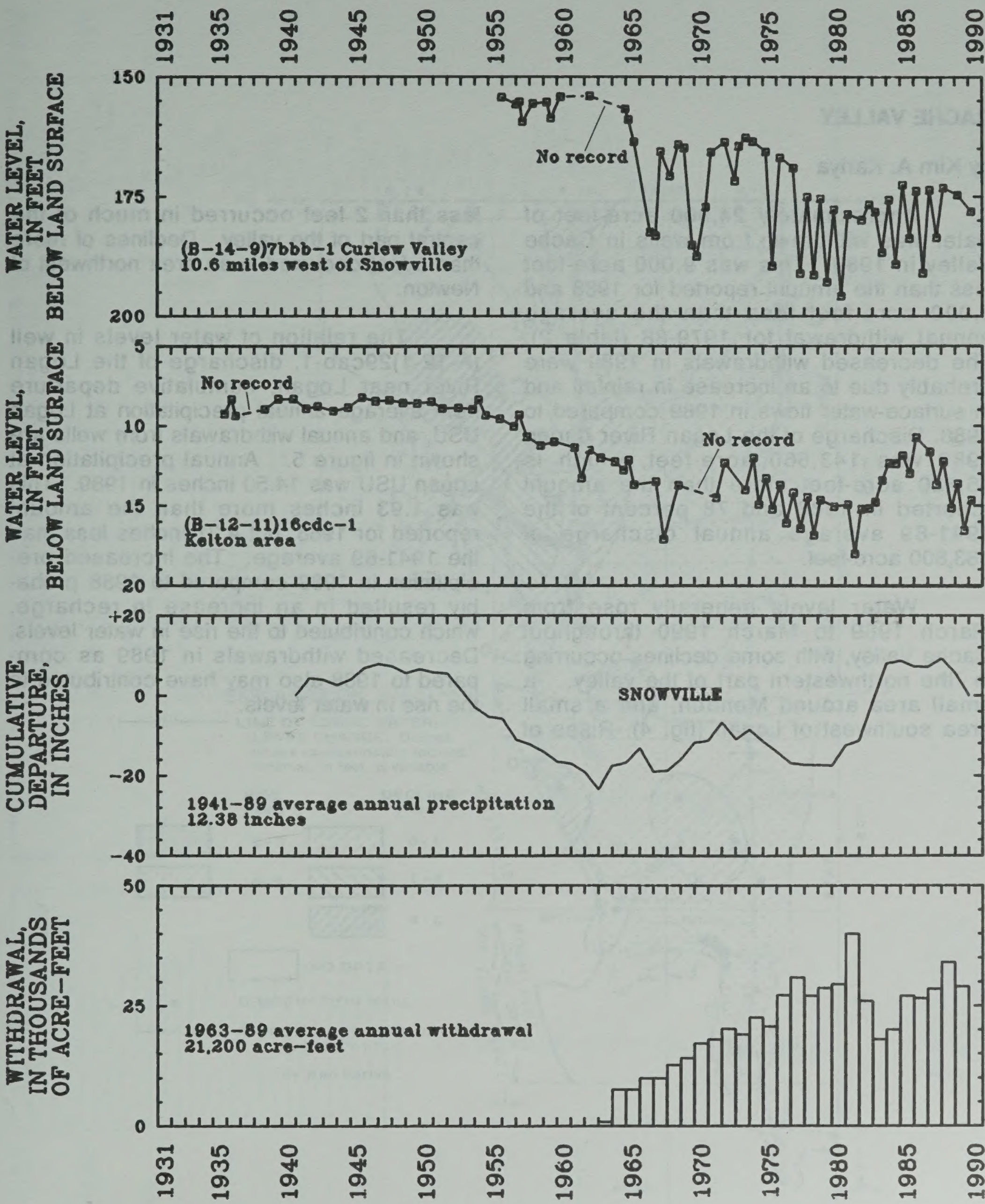


Figure 3.--Relation of water levels in selected wells in Curlew Valley to cumulative departure from the average annual precipitation at Snowville and to annual withdrawals from wells.

CACHE VALLEY

by Kim A. Kariya

Approximately 24,000 acre-feet of water was withdrawn from wells in Cache Valley in 1989. This was 9,000 acre-feet less than the amount reported for 1988 and 2,000 acre-feet less than the average annual withdrawal for 1979-88 (table 2). The decreased withdrawals in 1989 were probably due to an increase in rainfall and in surface-water flows in 1989 compared to 1988. Discharge of the Logan River during 1989 was 143,660 acre-feet, which is 46,720 acre-feet more than the amount reported in 1988 and 78 percent of the 1941-89 average annual discharge of 183,800 acre-feet.

Water levels generally rose from March 1989 to March 1990 throughout Cache Valley, with some declines occurring in the northwestern part of the valley, a small area around Mendon, and a small area southwest of Logan (fig. 4). Rises of less than 2 feet occurred in much of the central part of the valley. Declines of more than 5 feet occurred in an area northwest of Newton.

The relation of water levels in well (A-12-1)29cab-1, discharge of the Logan River near Logan, cumulative departure from average annual precipitation at Logan USU, and annual withdrawals from wells are shown in figure 5. Annual precipitation at Logan USU was 14.50 inches in 1989. This was 1.93 inches more than the amount reported for 1988, but 4.21 inches less than the 1941-89 average. The increased precipitation in 1989 compared to 1988 probably resulted in an increase in recharge, which contributed to the rise in water levels. Decreased withdrawals in 1989 as compared to 1988 also may have contributed to the rise in water levels.

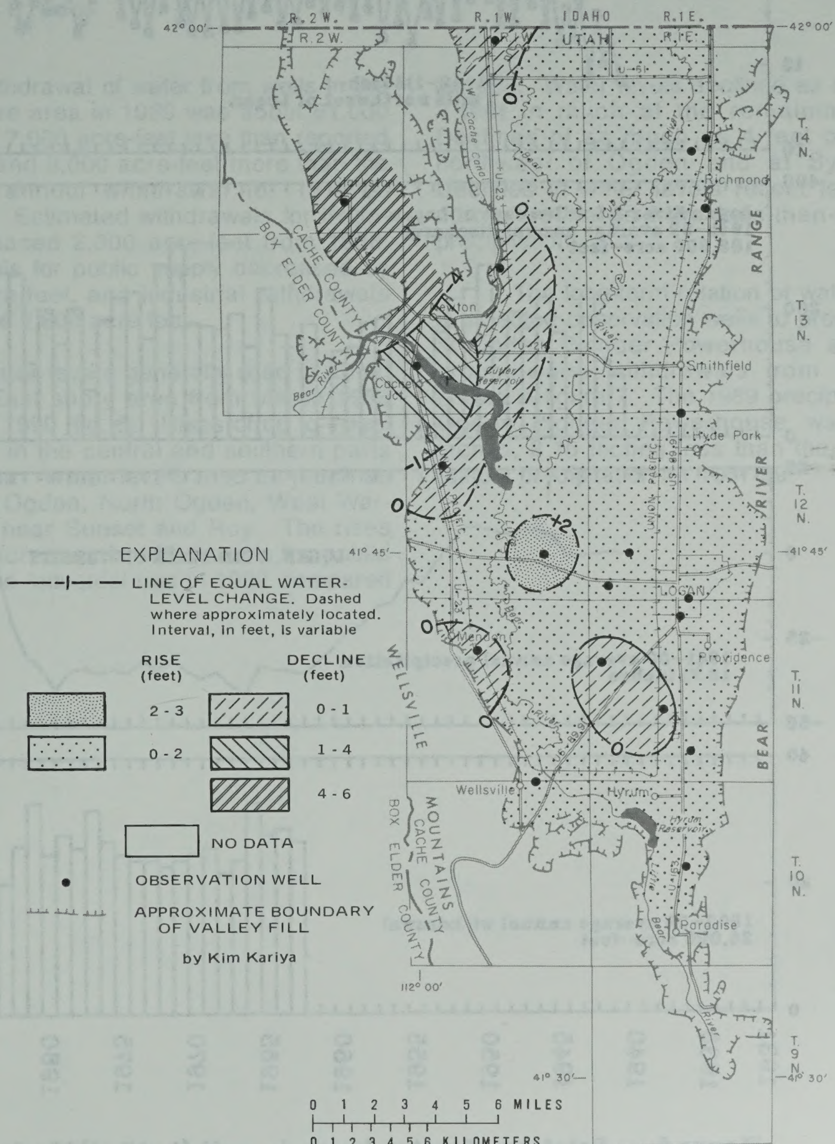


Figure 4.--Map of Cache Valley showing change of water levels from March 1989 to March 1990.

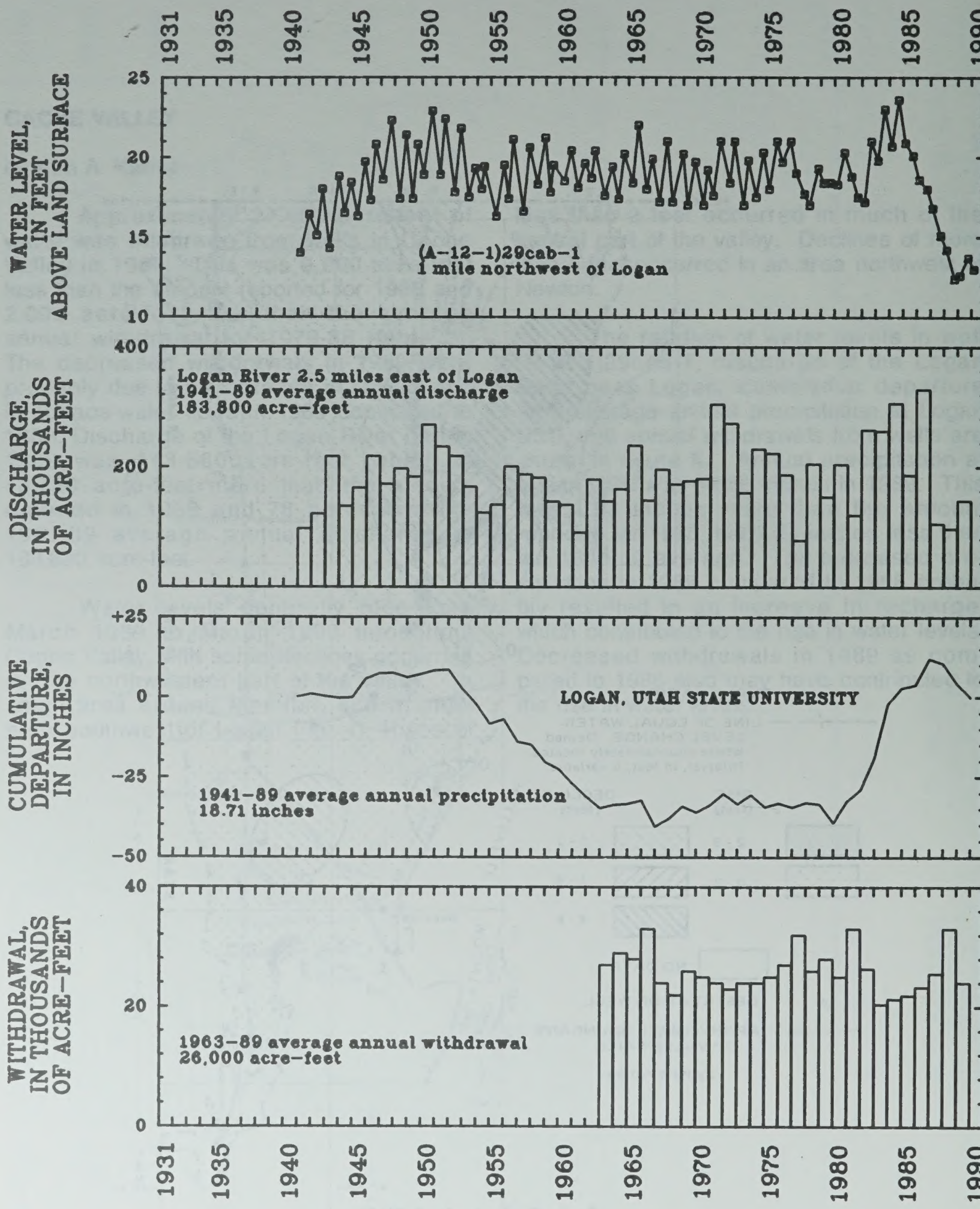


Figure 5.--Relation of water levels in well (A-12-1)29cab-1 in Cache Valley to discharge of the Logan River near Logan, to cumulative departure from the average annual precipitation at Logan, Utah State University, and to annual withdrawals from wells.

EAST SHORE AREA

by James P. Eads

Withdrawal of water from wells in the East Shore area in 1989 was about 61,000 acre-feet, 7,000 acre-feet less than reported for 1988 and 9,000 acre-feet more than the average annual withdrawal for 1979-88 (table 2). Estimated withdrawals for irrigation increased 2,300 acre-feet from 1988, withdrawals for public supply decreased by 7,000 acre-feet, and industrial withdrawals decreased 2,600 acre feet.

Water levels generally rose in about half the East shore area from March 1989 to March 1990 (fig. 6). Rises of up to 7 feet occurred in the central and southern parts of the area. Water levels rose as much as 3 feet at Ogden, North Ogden, West Warren, and near Sunset and Roy. The rises reflect decreases in withdrawals for public supply and industrial use in 1989 compared to 1988. Water levels declined as much as 2 feet in much of the remaining area. Declines of as much as 4 feet occurred northwest of Ogden and at Syracuse. Declines in water levels reflect less-than-normal recharge from less-than-average precipitation.

The long-term relation of water levels in selected observation wells to precipitation at Ogden Pioneer Powerhouse and total ground-water withdrawals from wells is shown in figure 7. The 1989 precipitation at Ogden Pioneer Powerhouse was 13.39 inches, 8.16 inches less than the average annual precipitation for 1937-89.

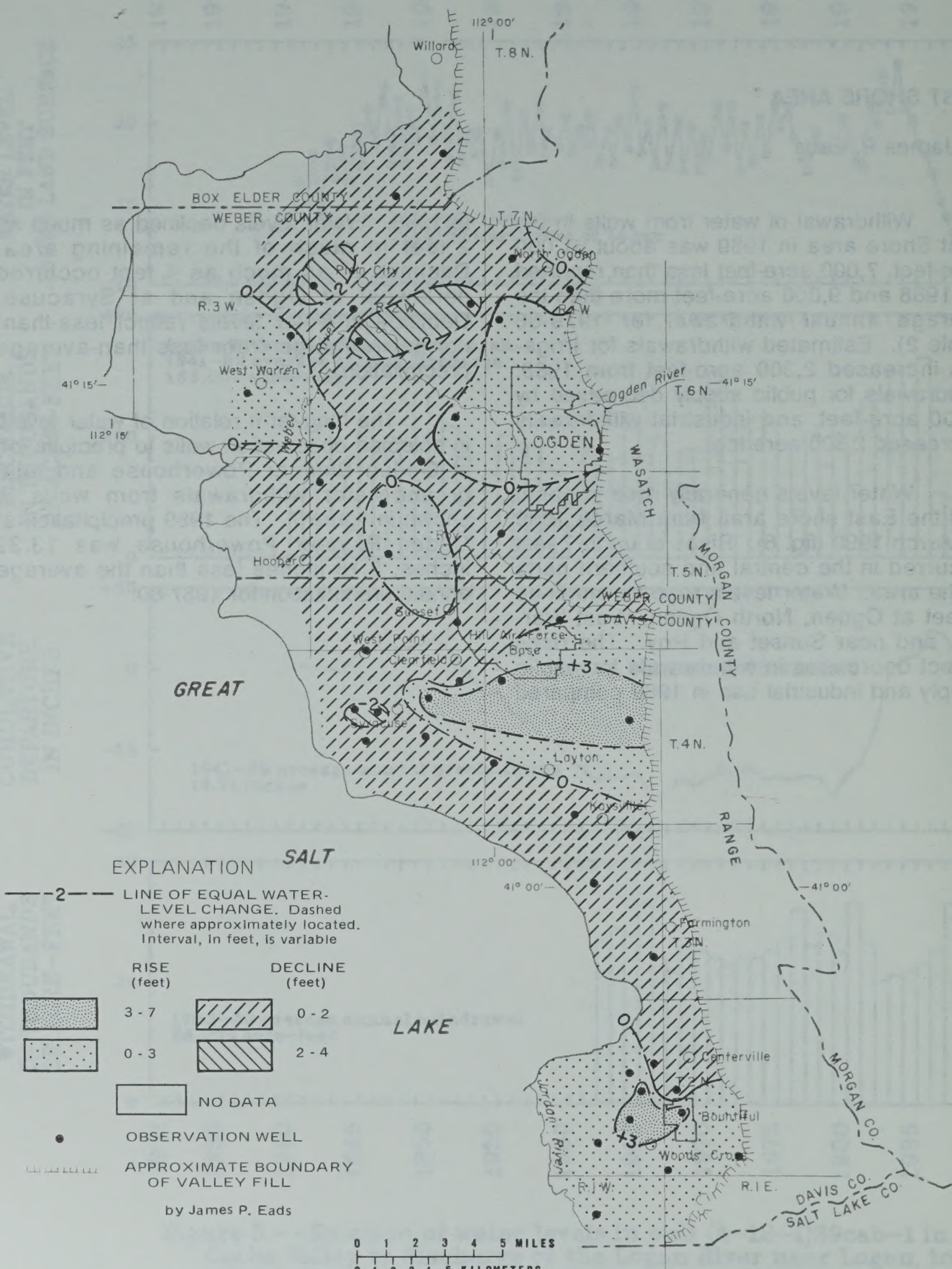


Figure 6.--Map of the East Shore area showing change of water levels from March 1989 to March 1990.

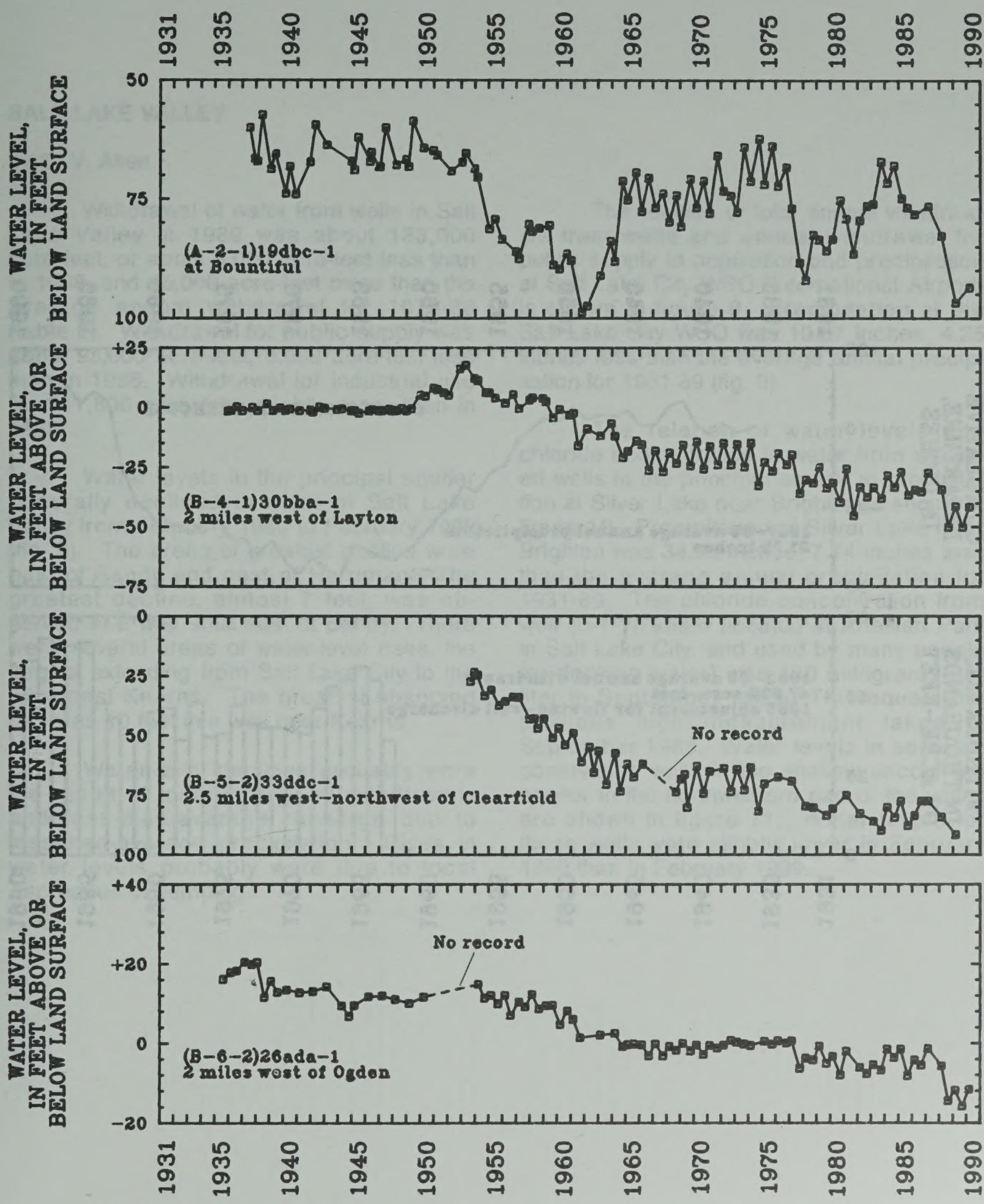


Figure 7.--Relation of water levels in selected wells in the East Shore area to cumulative departure from the average annual precipitation at Ogden Pioneer Powerhouse and to annual withdrawals from wells.

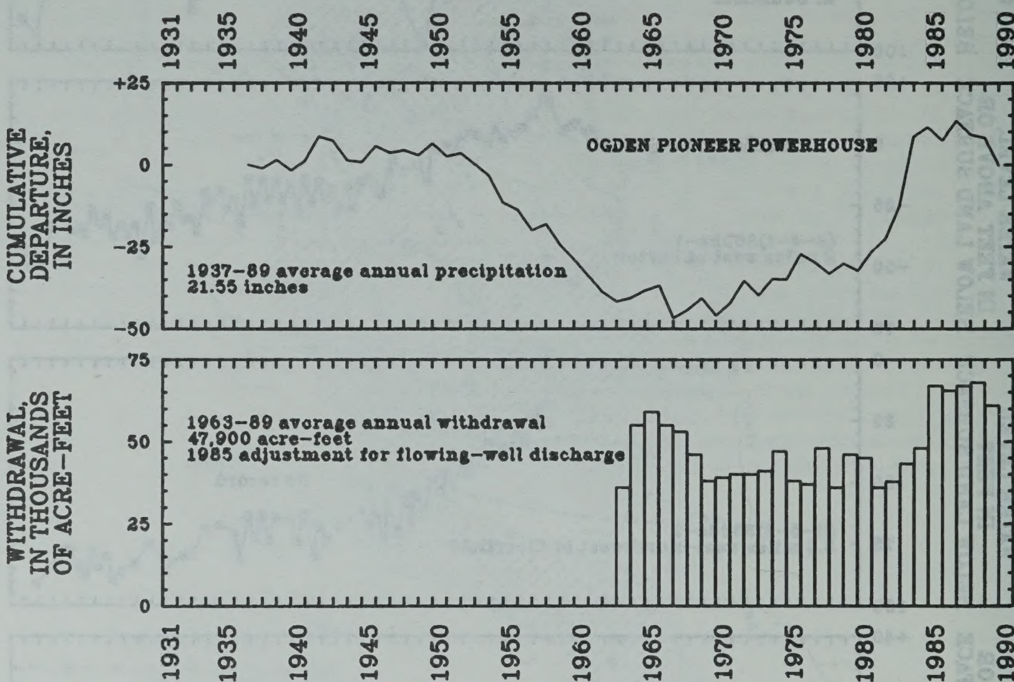


Figure 7.--Continued

SALT LAKE VALLEY

by D. V. Allen

Withdrawal of water from wells in Salt Lake Valley in 1989 was about 133,000 acre-feet, or about 8,000 acre-feet less than in 1988, and 15,000 acre-feet more than the average annual withdrawal for 1979-88 (table 2). Withdrawal for public supply was about 93,000 acre-feet, 8,000 acre-feet less than in 1988. Withdrawal for industrial use was 11,800 acre-feet, slightly more than in 1988.

Water levels in the principal aquifer generally declined in most of Salt Lake Valley from February 1989 to February 1990 (fig. 8). The areas of greatest decline were east of Sandy and east of Herriman. The greatest decline, almost 7 feet, was observed in a well southeast of Sandy. There were several areas of water-level rises, the largest extending from Salt Lake City to the west past Kearns. The greatest observed rise was 10 feet in a well near Kearns.

Water-level declines probably were the result of local increased withdrawals and less-than-average recharge due to less-than-average precipitation. Rises in water levels probably were due to local decreases in pumping.

The relation of total annual withdrawals from wells and annual withdrawal for public supply to population and precipitation at Salt Lake City WSO (International Airport) is shown in figure 9. Precipitation at the Salt Lake City WSO was 10.87 inches, 4.25 inches less than the average annual precipitation for 1931-89 (fig. 9).

The relation of water levels and chloride concentration in water from selected wells in the principal aquifer to precipitation at Silver Lake near Brighton is shown in figure 10. Precipitation at Silver Lake near Brighton was 34.92 inches, 7.74 inches less than the average annual precipitation for 1931-89. The chloride concentration from well (D-1-1)7abd-6 (located in Artesian Park in Salt Lake City, and used by many people for drinking water) was 130 milligrams per liter in September 1989. This equals the previous high measurement taken in September 1988. Water levels in selected observation wells in the shallow unconfined aquifer in the northwestern part of the valley are shown in figure 11. Water levels for these wells were slightly lower in February 1990 than in February 1989.

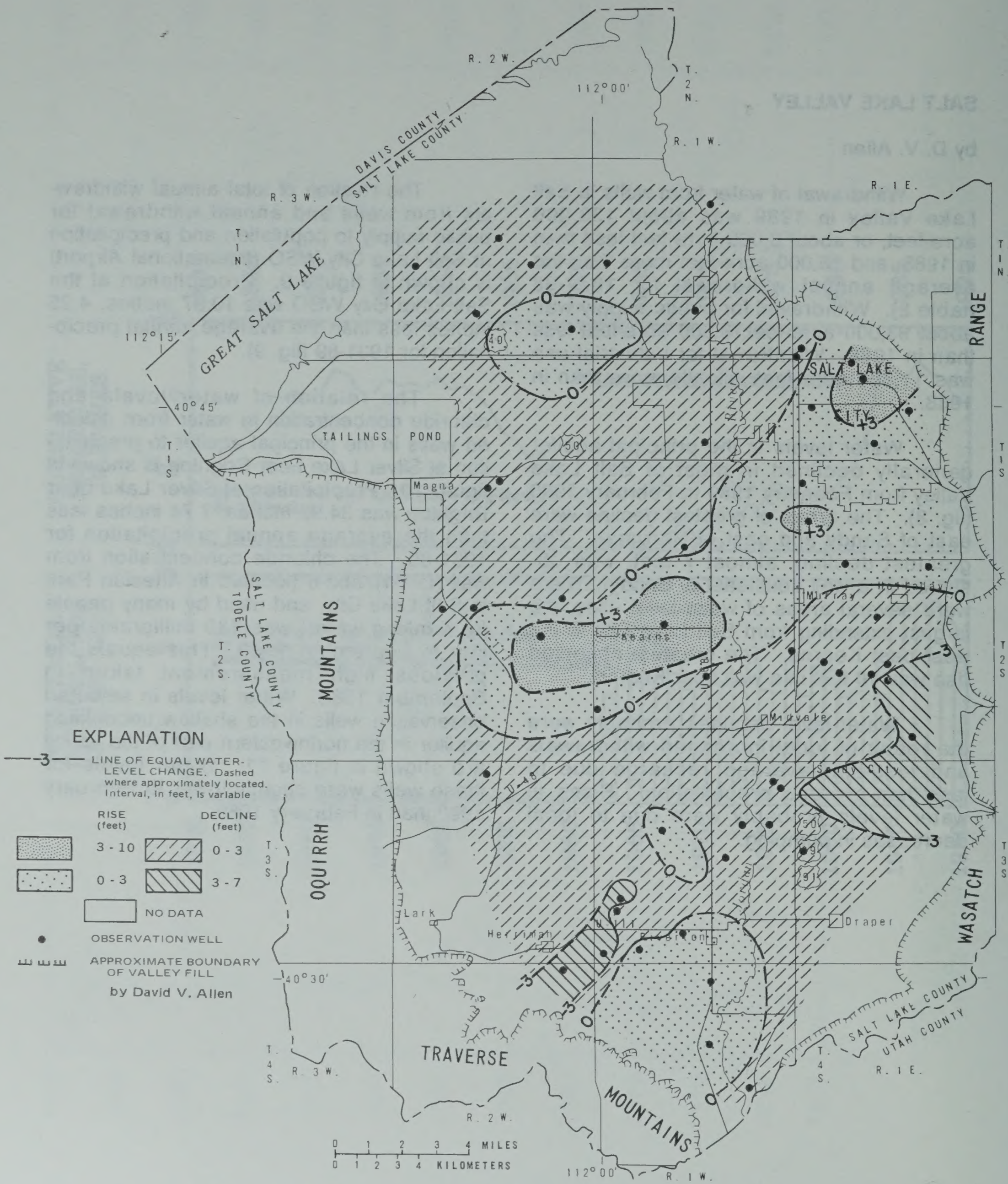


Figure 8.--Map of the Salt Lake Valley showing change of water levels in the principal aquifer from February 1989 to February 1990.

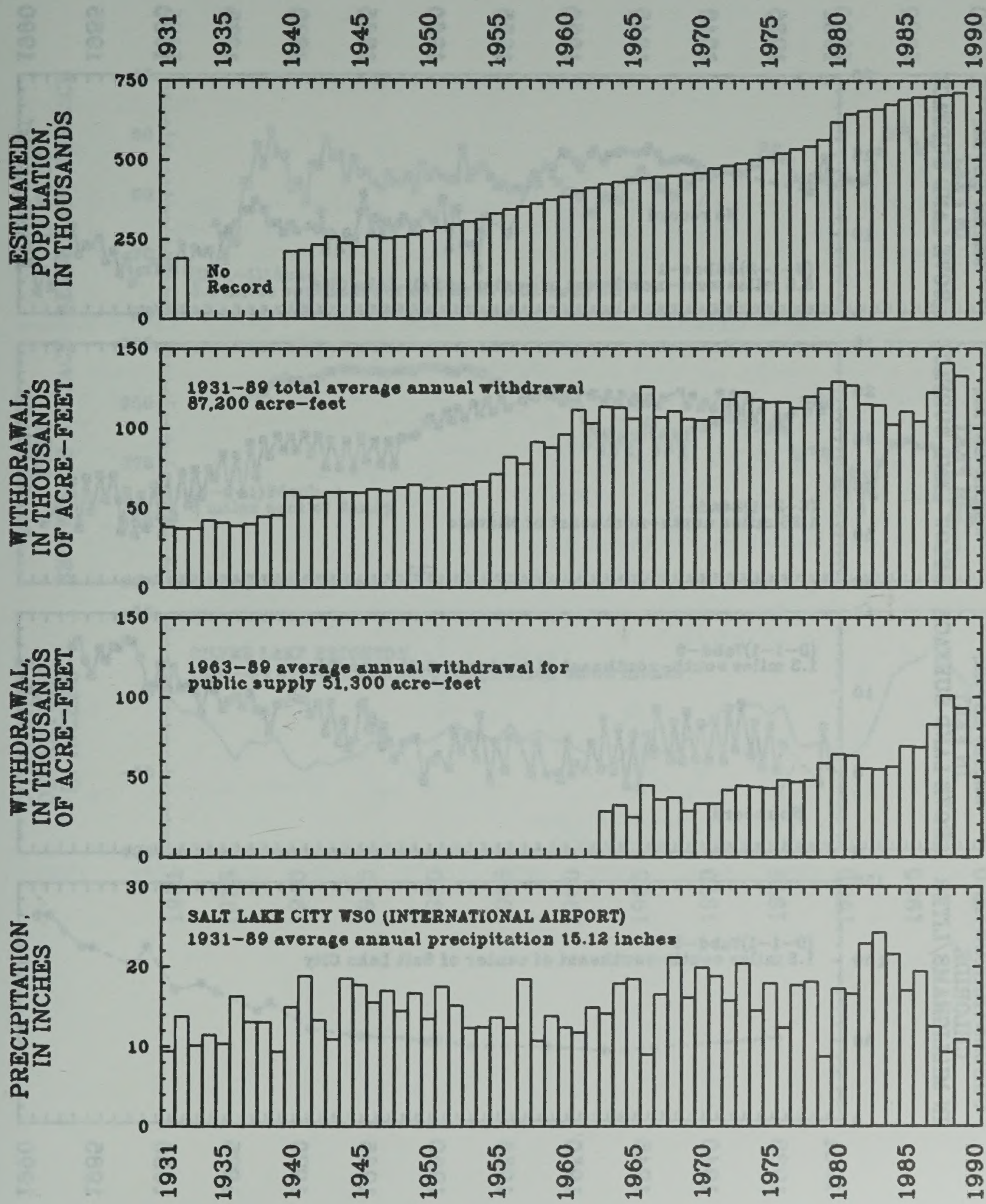


Figure 9.––Estimated population of Salt Lake County, total annual withdrawals from wells, annual withdrawal for public supply, and average annual precipitation at Salt Lake City WSO (International Airport).

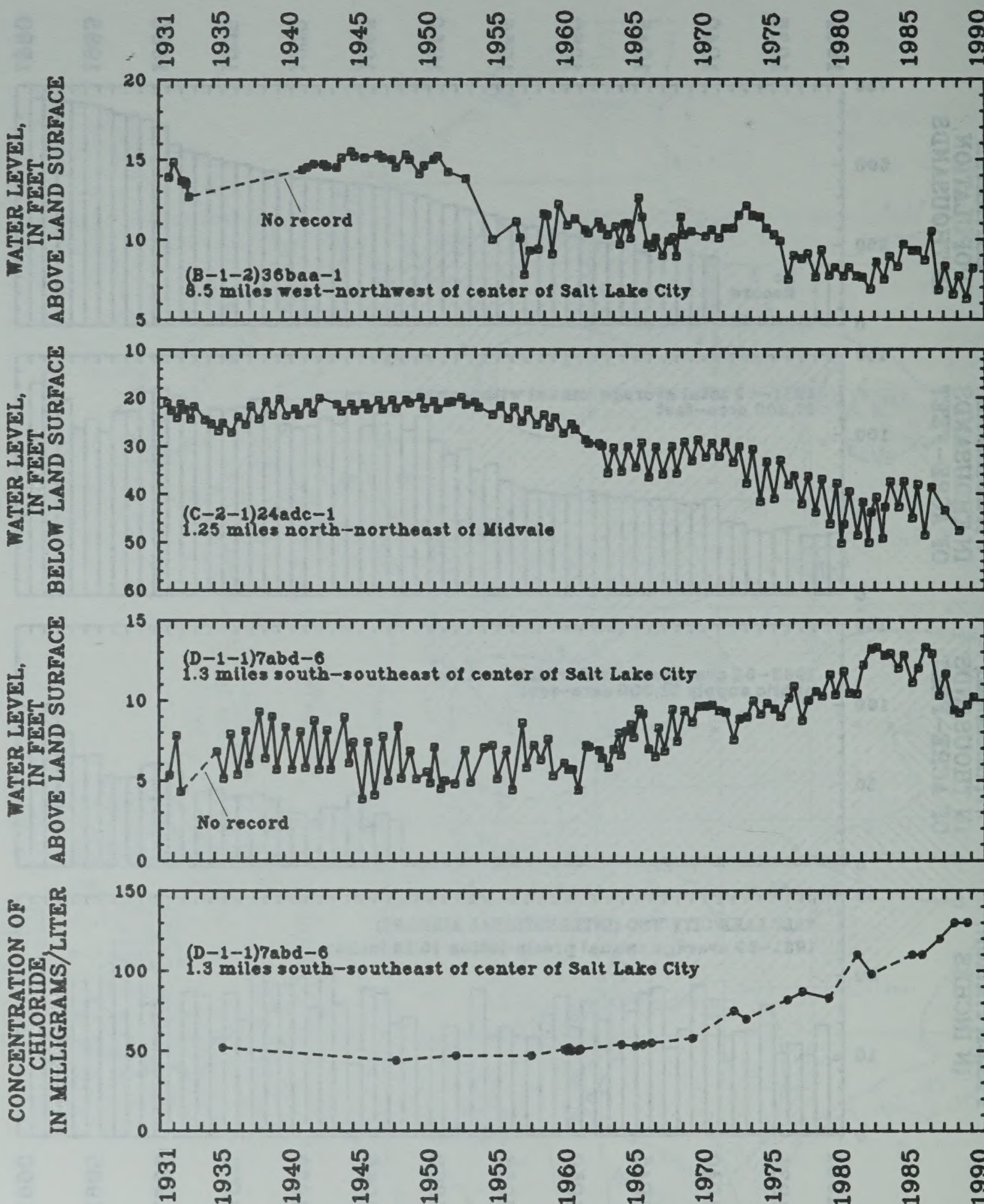


Figure 10.--Relation of water levels and chloride concentration in water from selected wells in the principal aquifer in Salt Lake Valley to cumulative departure from the average annual precipitation at Silver Lake Brighton.

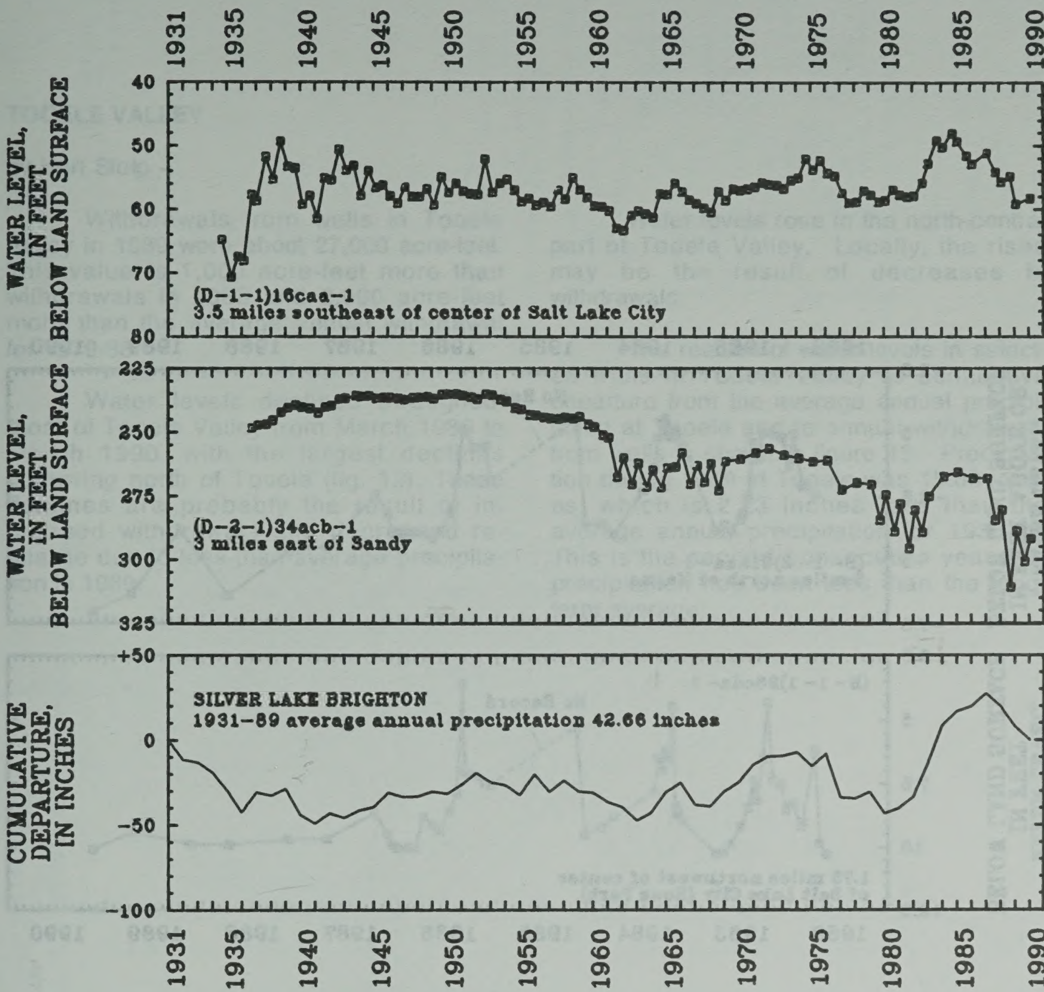


Figure 10.--Continued

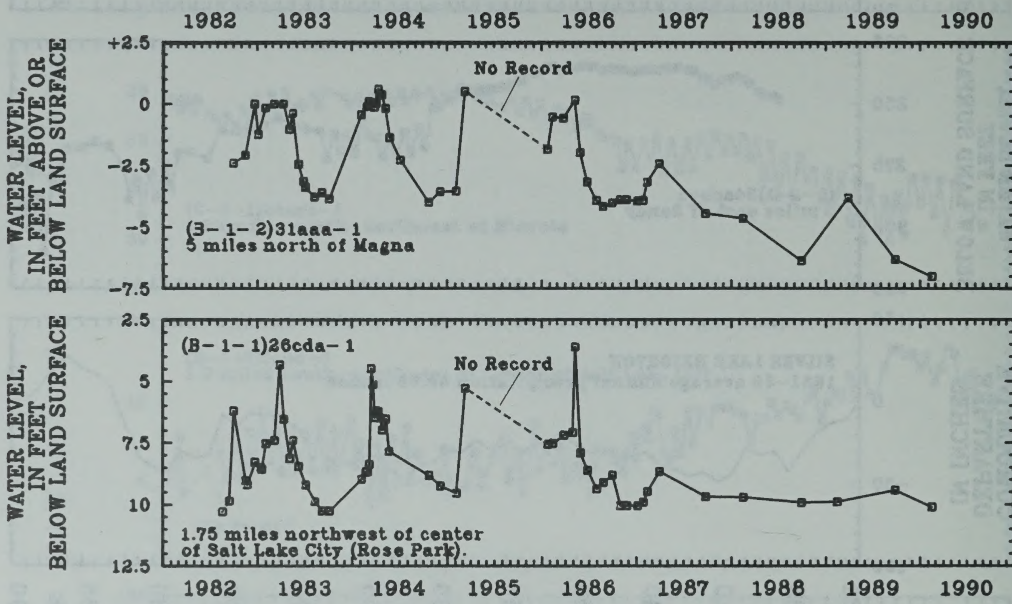


Figure 11.--Water levels in selected wells in the shallow unconfined aquifer in Salt Lake Valley.

TOOELE VALLEY

by Bert Stolp

Withdrawals from wells in Tooele Valley in 1989 were about 27,000 acre-feet. This value is 1,000 acre-feet more than withdrawals in 1988 and 2,000 acre-feet more than the average annual withdrawal for 1979-88.

Water levels declined throughout most of Tooele Valley from March 1989 to March 1990, with the largest declines occurring north of Tooele (fig. 12). These declines are probably the result of increased withdrawals and decreased recharge due to less-than-average precipitation in 1989.

Water levels rose in the north-central part of Tooele Valley. Locally, the rises may be the result of decreases in withdrawals.

The relation of water levels in selected wells in Tooele Valley to cumulative departure from the average annual precipitation at Tooele and to annual withdrawals from wells is shown in figure 13. Precipitation during 1989 at Tooele was 15.09 inches, which is 2.23 inches less than the average annual precipitation for 1936-89. This is the second consecutive year that precipitation has been less than the long-term average.

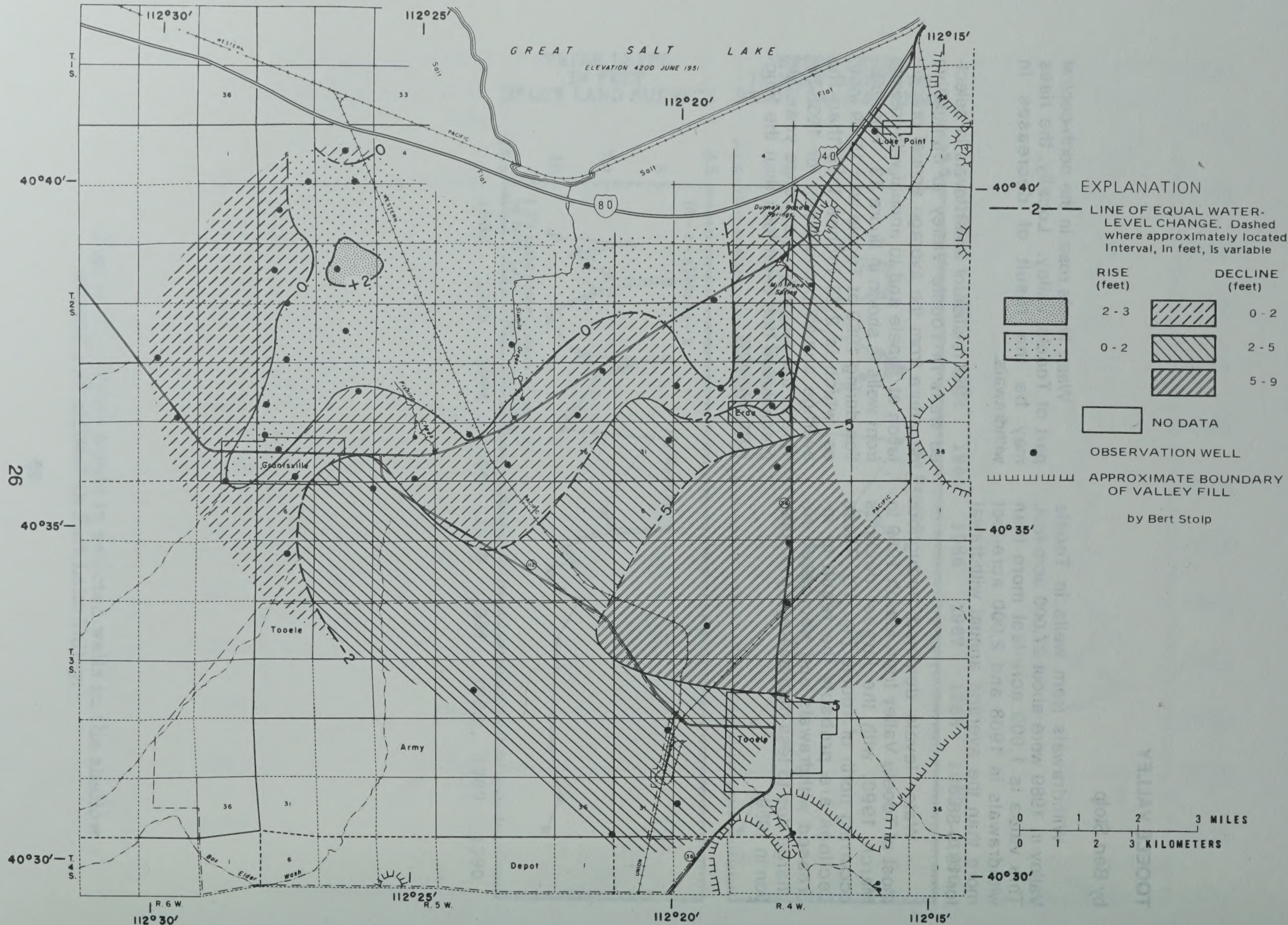


Figure 12.--Map of Tooele Valley showing change of water levels in artesian aquifers from March 1989 to March 1990.

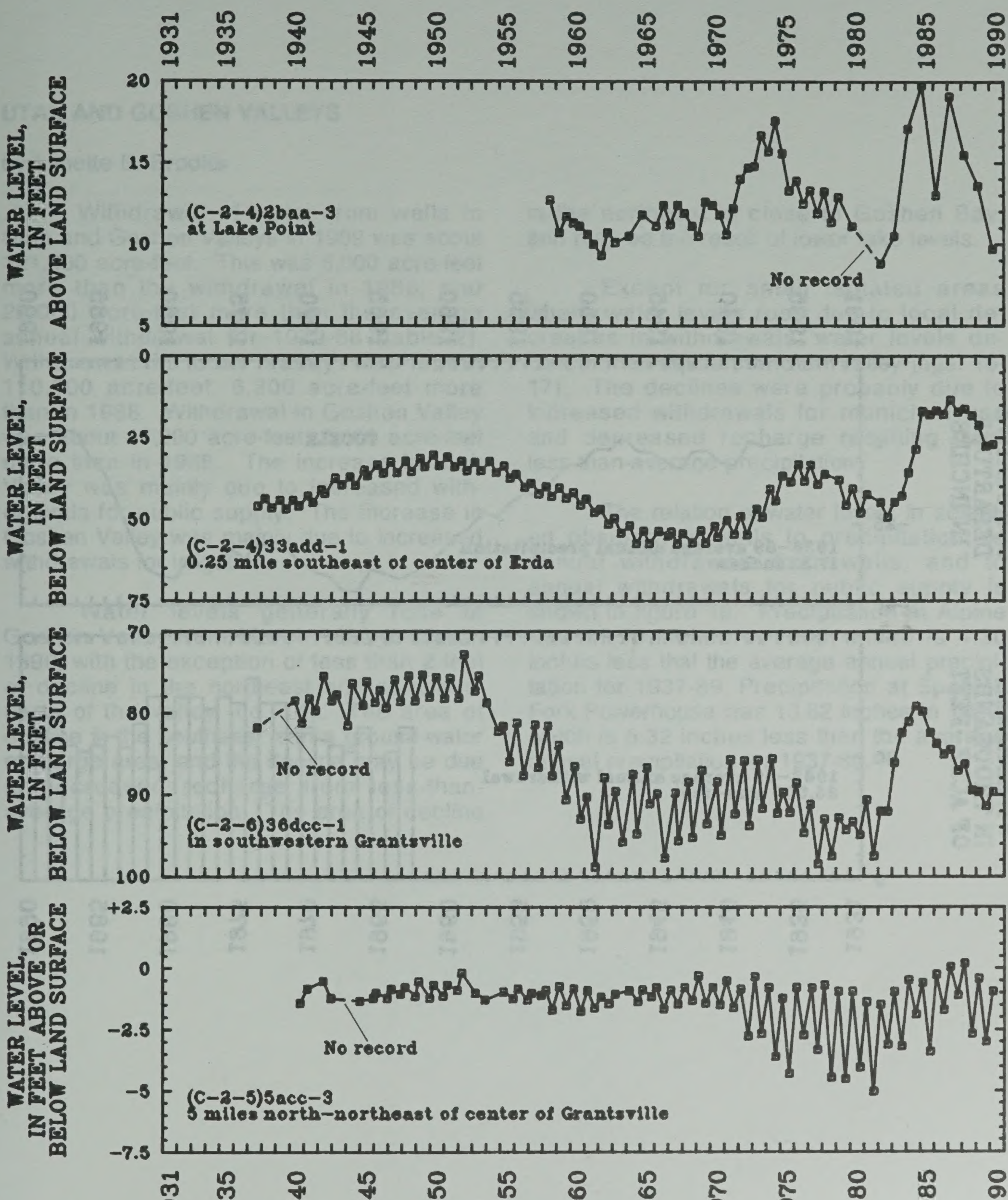


Figure 13.--Relation of water levels in selected wells in Tooele Valley to cumulative departure from the average annual precipitation at Tooele and to annual withdrawals from wells.

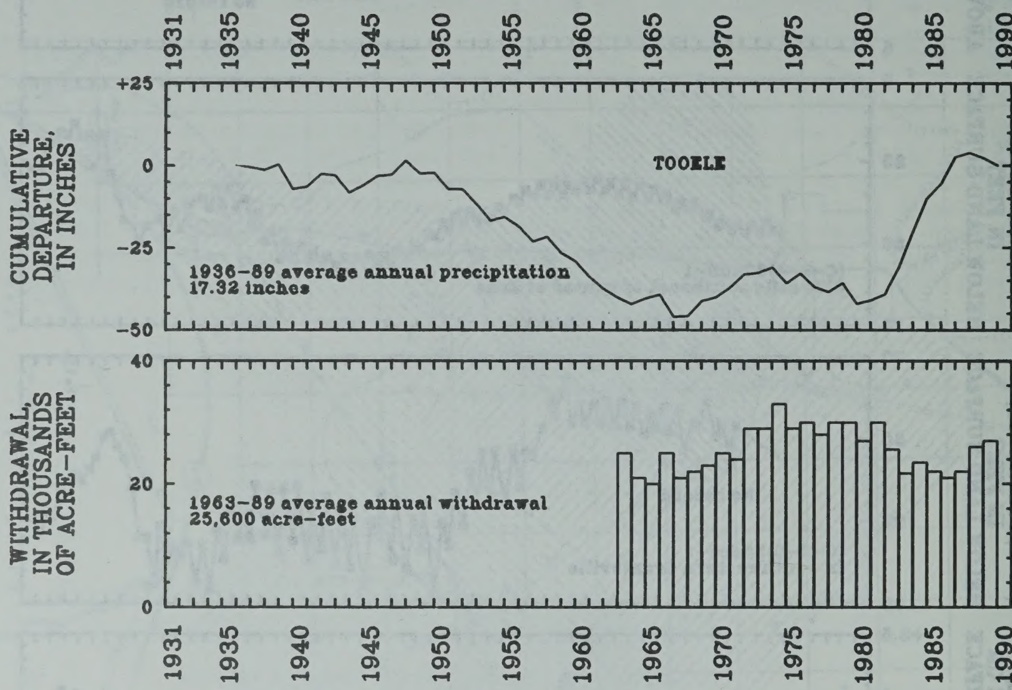


Figure 13.--Continued

UTAH AND GOSHEN VALLEYS

by Lynette E. Brooks

Withdrawal of water from wells in Utah and Goshen Valleys in 1989 was about 121,000 acre-feet. This was 8,000 acre-feet more than the withdrawal in 1988, and 29,000 acre-feet more than the average annual withdrawal for 1979-88 (table 2). Withdrawal in Utah Valley was about 110,100 acre-feet, 6,300 acre-feet more than in 1988. Withdrawal in Goshen Valley was about 11,200 acre-feet, 2,000 acre-feet more than in 1988. The increase in Utah Valley was mainly due to increased withdrawals for public supply. The increase in Goshen Valley was mainly due to increased withdrawals for irrigation.

Water levels generally rose in Goshen Valley from March 1989 to March 1990, with the exception of less than 2 feet of decline in the northeast and southeast parts of the valley (fig. 14). The area of decline in the southeast is in a ground-water recharge area, and the decline may be due to decreased recharge from less-than-average precipitation. The area of decline in the northeast is close to Goshen Bay, and may be the result of lower lake levels.

Except for small isolated areas where water levels rose due to local decreases in withdrawals, water levels declined in all aquifers in Utah Valley (figs. 15-17). The declines were probably due to increased withdrawals for municipal use and decreased recharge resulting from less-than-average precipitation.

The relation of water levels in selected observation wells to precipitation, to annual withdrawals from wells, and to annual withdrawals for public supply is shown in figure 18. Precipitation at Alpine was 11.76 inches in 1989, which is 4.30 inches less that the average annual precipitation for 1937-89. Precipitation at Spanish Fork Powerhouse was 13.82 inches in 1989, which is 5.32 inches less than the average annual precipitation for 1937-89.

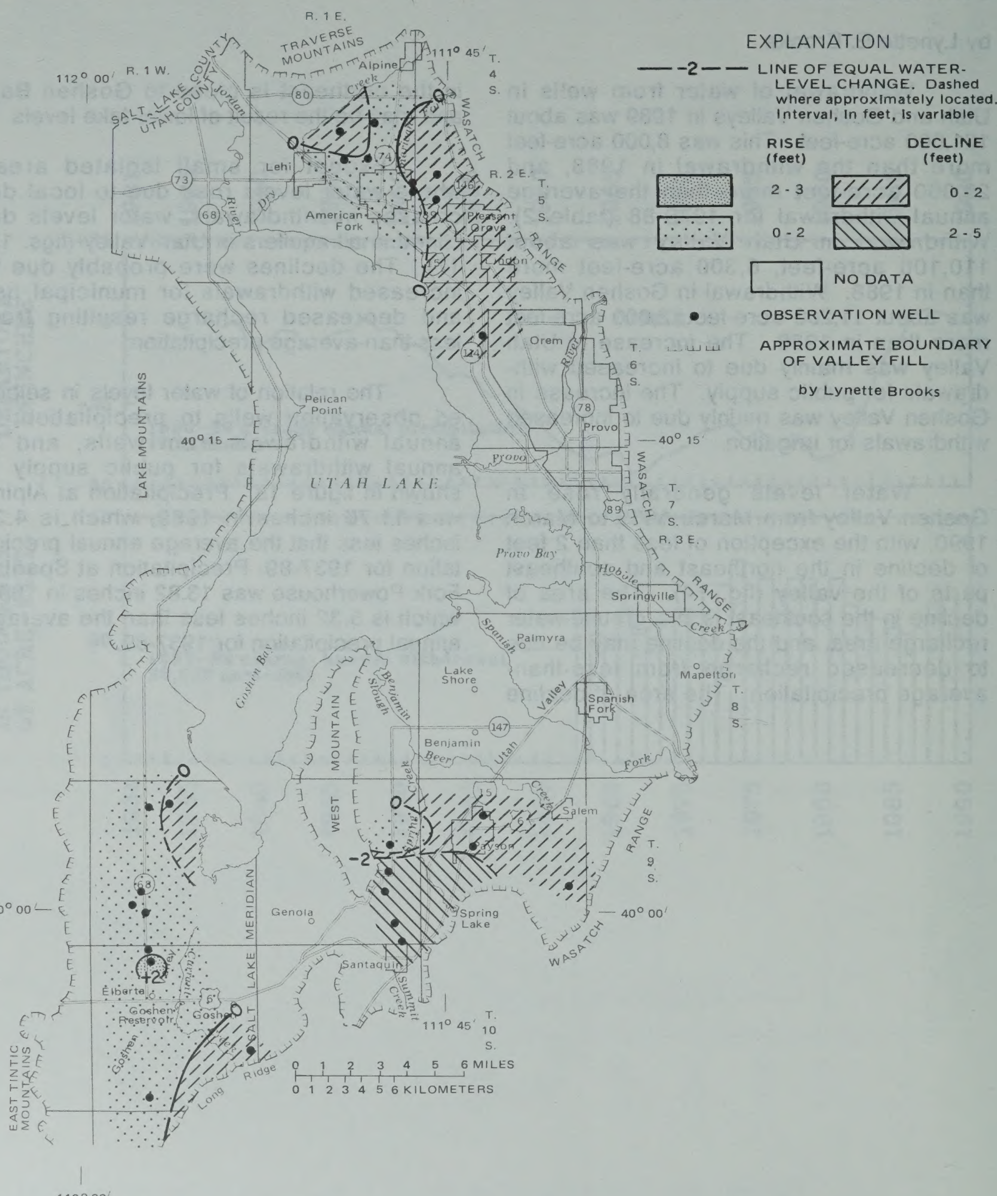


Figure 14.--Map of Utah and Goshen Valleys showing change of water levels in the water-table aquifers from March 1989 to March 1990.

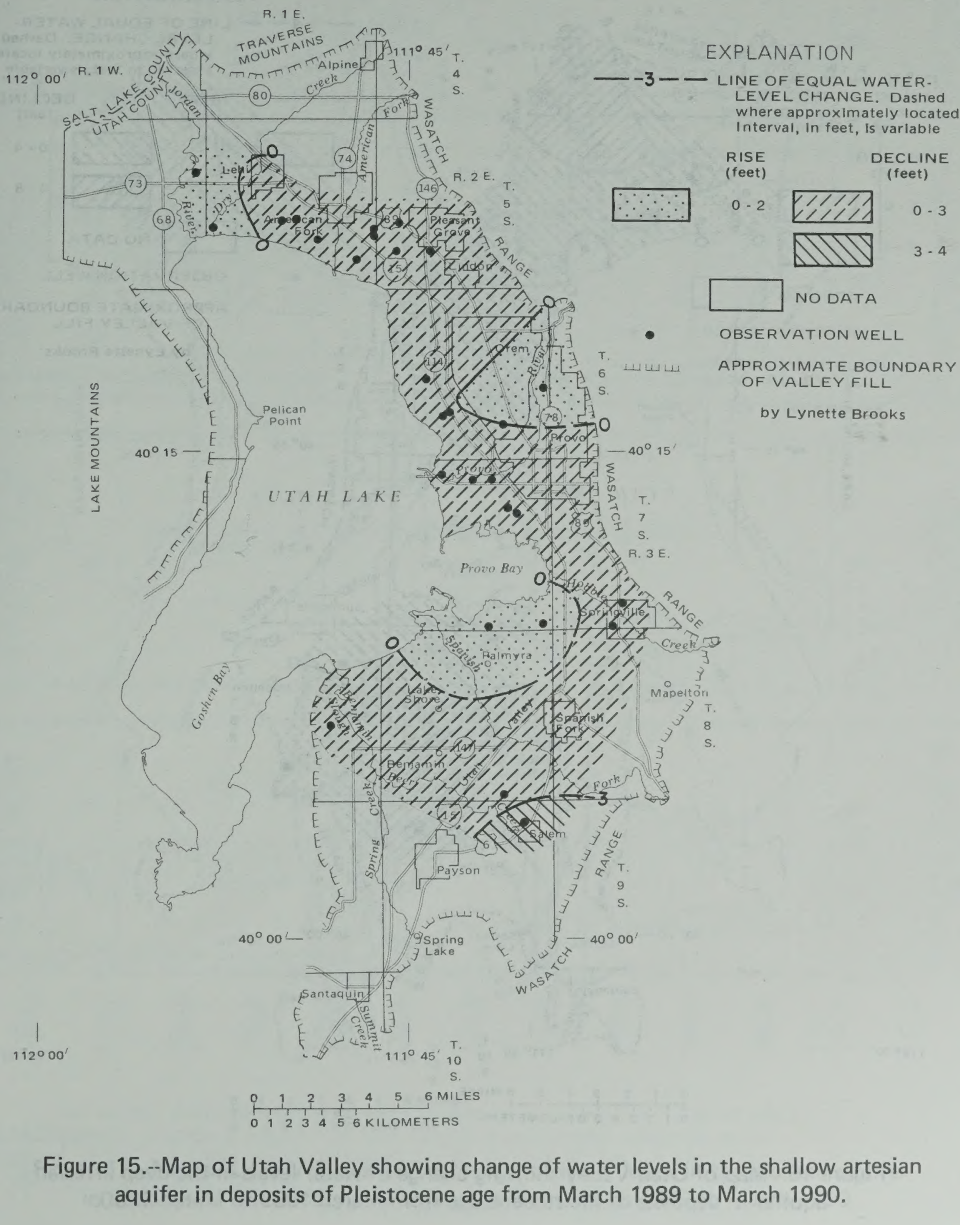


Figure 15.--Map of Utah Valley showing change of water levels in the shallow artesian aquifer in deposits of Pleistocene age from March 1989 to March 1990.

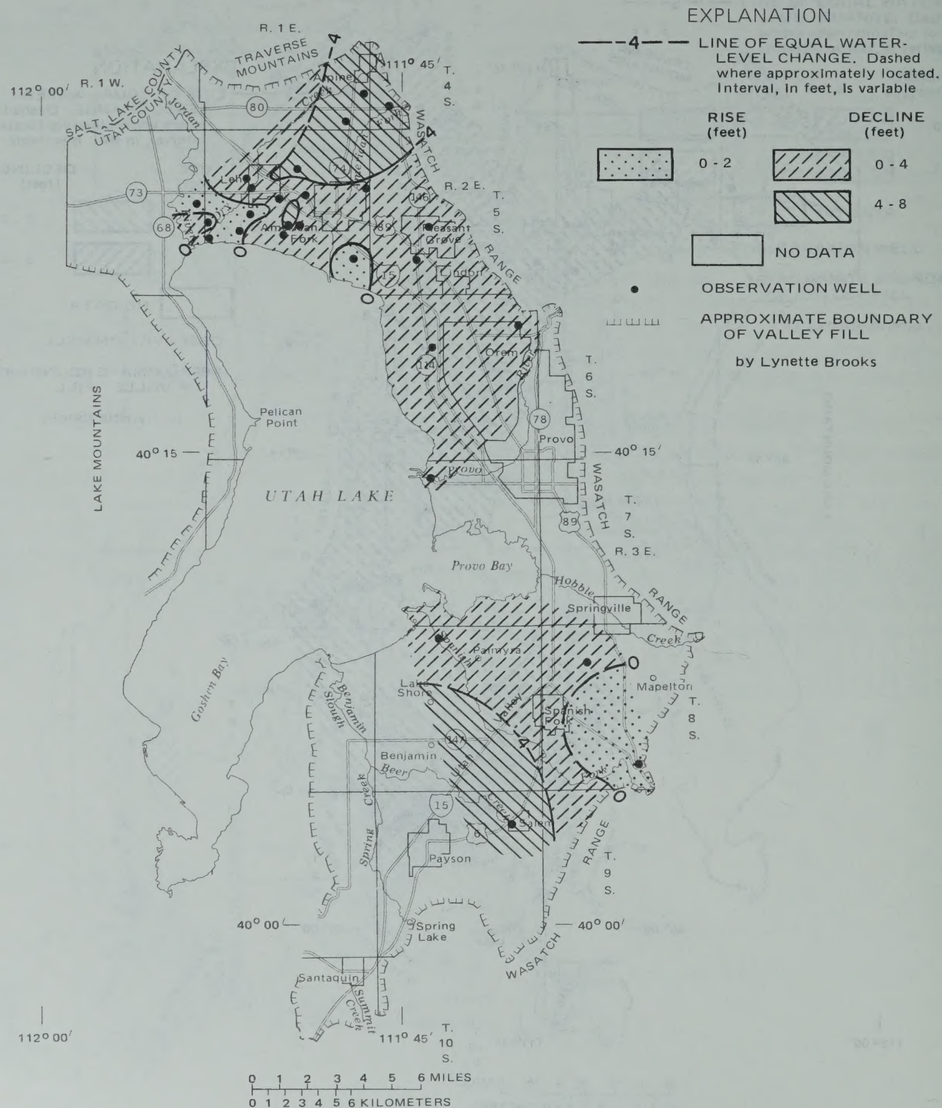


Figure 16.--Map of Utah Valley showing change of water levels in the deep artesian aquifer in deposits of Pleistocene age from March 1989 to March 1990.

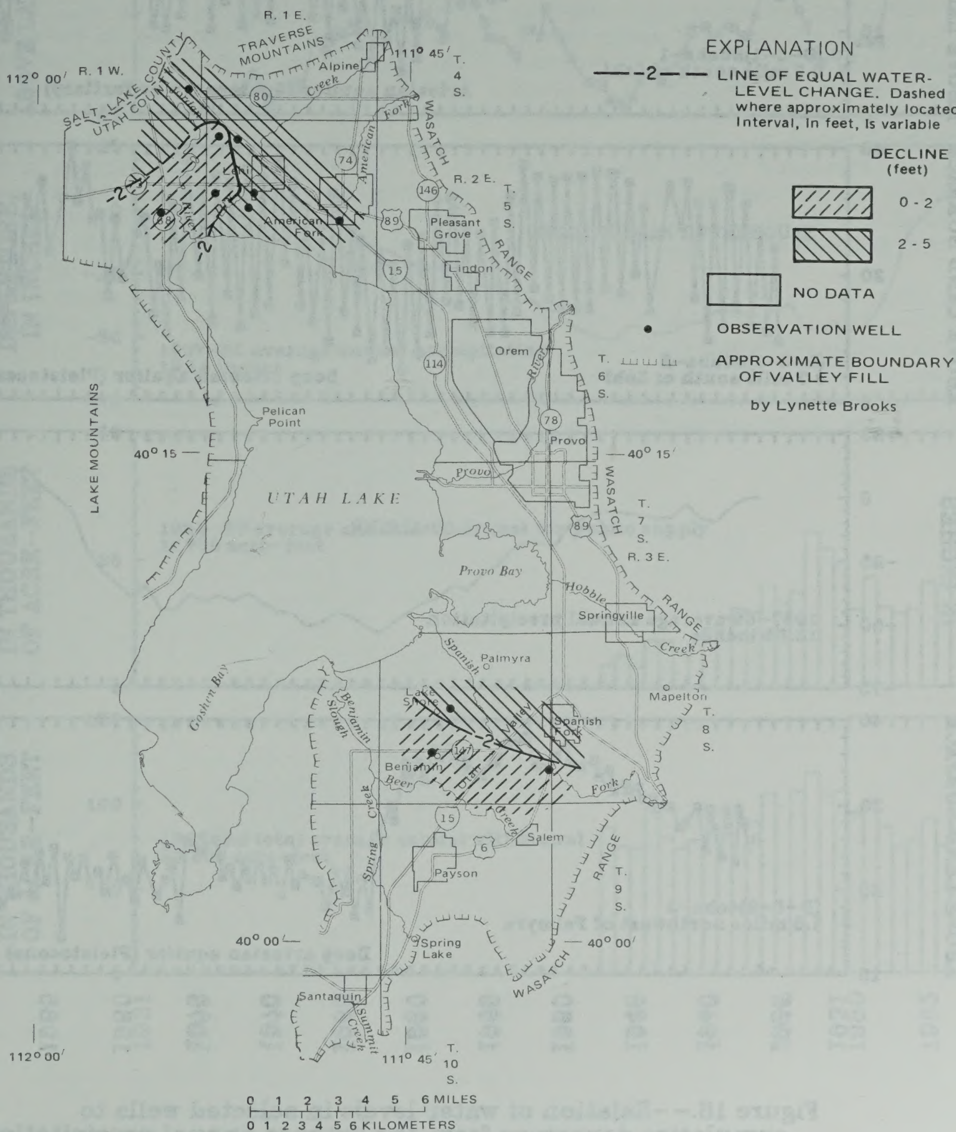


Figure 17.--Map of Utah Valley showing change of water levels in the artesian aquifer in deposits of Quaternary or Tertiary age from March 1989 to March 1990.

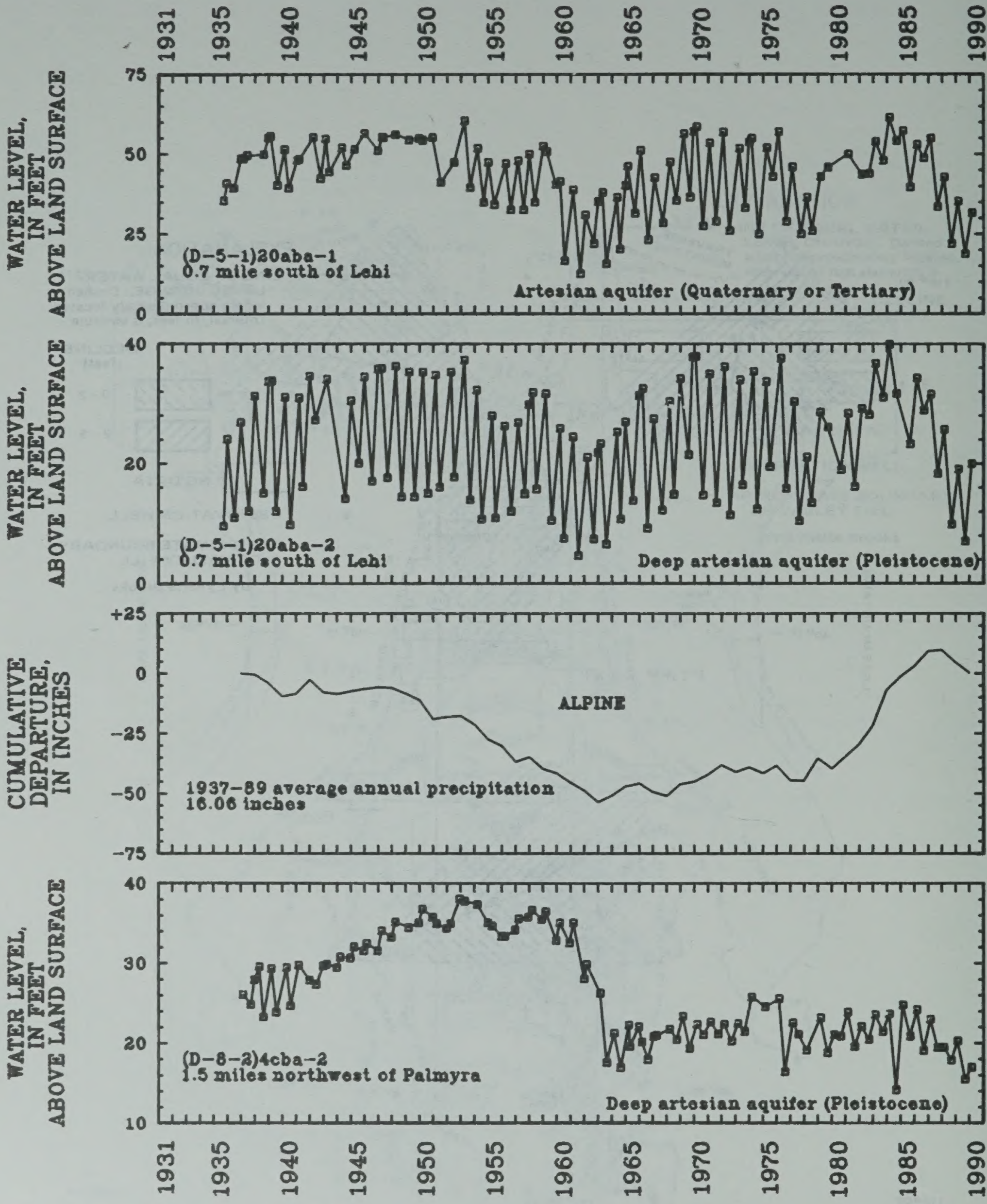


Figure 18.--Relation of water levels in selected wells to cumulative departure from the average annual precipitation at Alpine and Spanish Fork Powerhouse, and to total annual withdrawals from wells and annual withdrawals for public supply in Utah and Goshen Valleys.

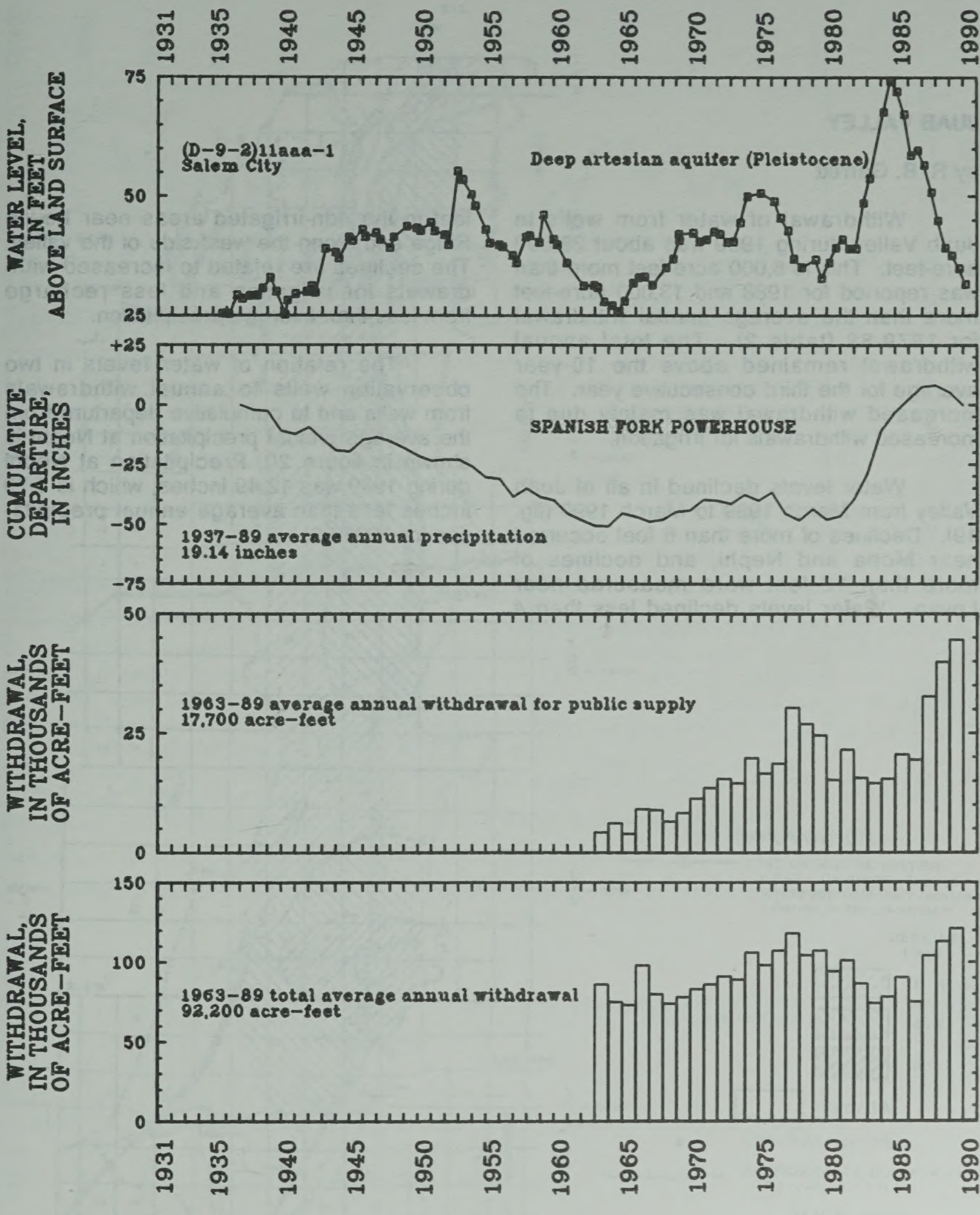


Figure 18.--Continued

JUAB VALLEY

by R. B. Garrett

Withdrawal of water from wells in Juab Valley during 1989 was about 28,000 acre-feet. This is 6,000 acre-feet more than was reported for 1988 and 13,000 acre-feet more than the average annual withdrawal for 1979-88 (table 2). The total annual withdrawal remained above the 10-year average for the third consecutive year. The increased withdrawal was mainly due to increased withdrawals for irrigation.

Water levels declined in all of Juab Valley from March 1989 to March 1990 (fig. 19). Declines of more than 6 feet occurred near Mona and Nephi, and declines of more than 12 feet were measured near Levan. Water levels declined less than 4 feet in the non-irrigated areas near Levan Ridge and along the west side of the valley. The declines are related to increased withdrawals for irrigation and less recharge from less-than-average precipitation.

The relation of water levels in two observation wells to annual withdrawals from wells and to cumulative departure from the average annual precipitation at Nephi is shown in figure 20. Precipitation at Nephi during 1989 was 12.49 inches, which is 1.79 inches less than average annual precipitation for 1935-89.

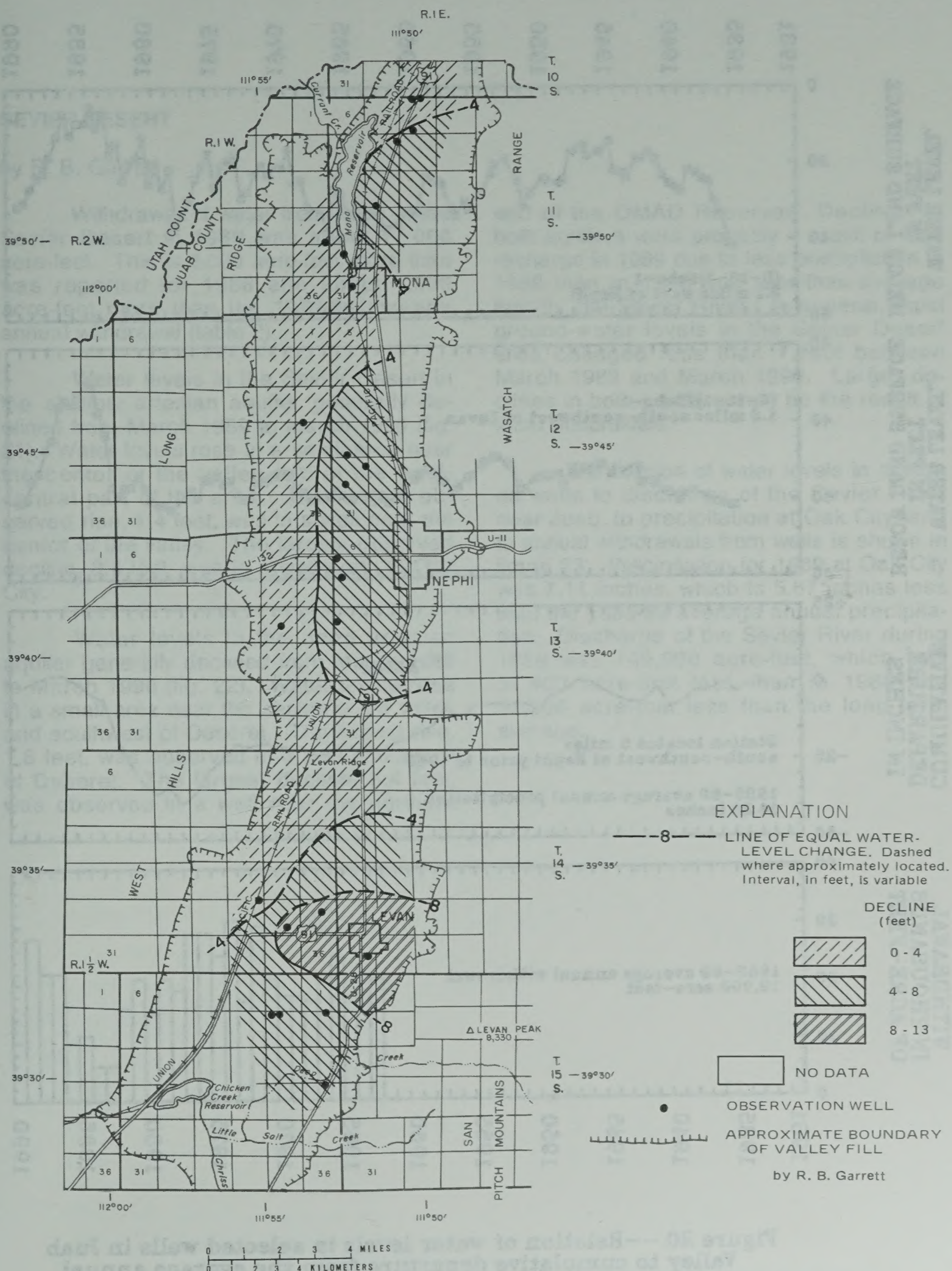


Figure 19.--Map of Juab Valley showing change of water levels from March 1989 to March 1990.

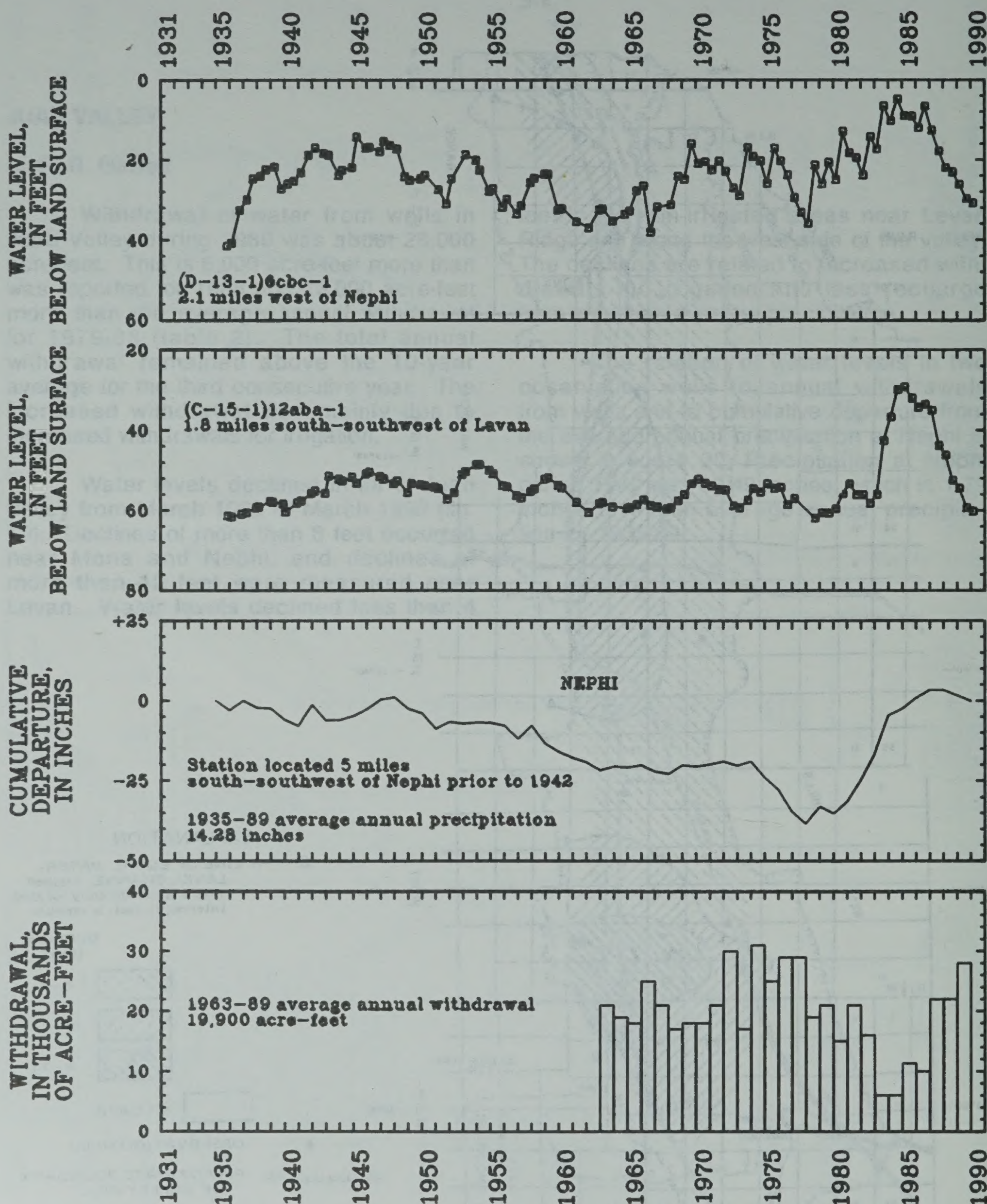


Figure 20.--Relation of water levels in selected wells in Juab Valley to cumulative departure from the average annual precipitation at Nephi and to annual withdrawals from wells.

SEVIER DESERT

by R. B. Garrett

Withdrawal of water from wells in the Sevier Desert in 1989 was about 17,000 acre-feet. This is 2,000 acre-feet more than was reported for 1988 and about 1,000 acre-feet more than the 1979-88 average annual withdrawal (table 2).

Water levels in the Sevier Desert in the shallow artesian aquifer generally declined from March 1989 to March 1990 (fig. 21). Water levels rose in a small area near the center of the valley and in the west-central part of the area. The largest observed rise, 1.4 feet, was in a well near the center of the valley. The largest observed decline, 8.4 feet, was in a well north of Oak City.

Water levels in the deep artesian aquifer generally declined from March 1989 to March 1990 (fig. 22). Water levels rose in a small area near the center of the valley and southwest of Deseret. The largest rise, 1.6 feet, was observed in a well southwest of Deseret. The largest decline, 8.4 feet, was observed in a well near the northern end of the DMAD Reservoir. Declines in both aquifers were probably a result of less recharge in 1989 due to less precipitation in 1989 than in 1988 and less-than-average flow in the Sevier River. In general, most ground-water levels in the Sevier Desert area changed less than 1 foot between March 1989 and March 1990. Larger declines in both aquifers may be the result of local withdrawals.

The relation of water levels in selected wells to discharge of the Sevier River near Juab, to precipitation at Oak City, and to annual withdrawals from wells is shown in figure 23. Precipitation for 1989 at Oak City was 7.11 inches, which is 5.67 inches less than the 1935-89 average annual precipitation. Discharge of the Sevier River during 1989 was 149,900 acre-feet, which was 31,800 acre-feet less than in 1988 and 37,300 acre-feet less than the long term average.

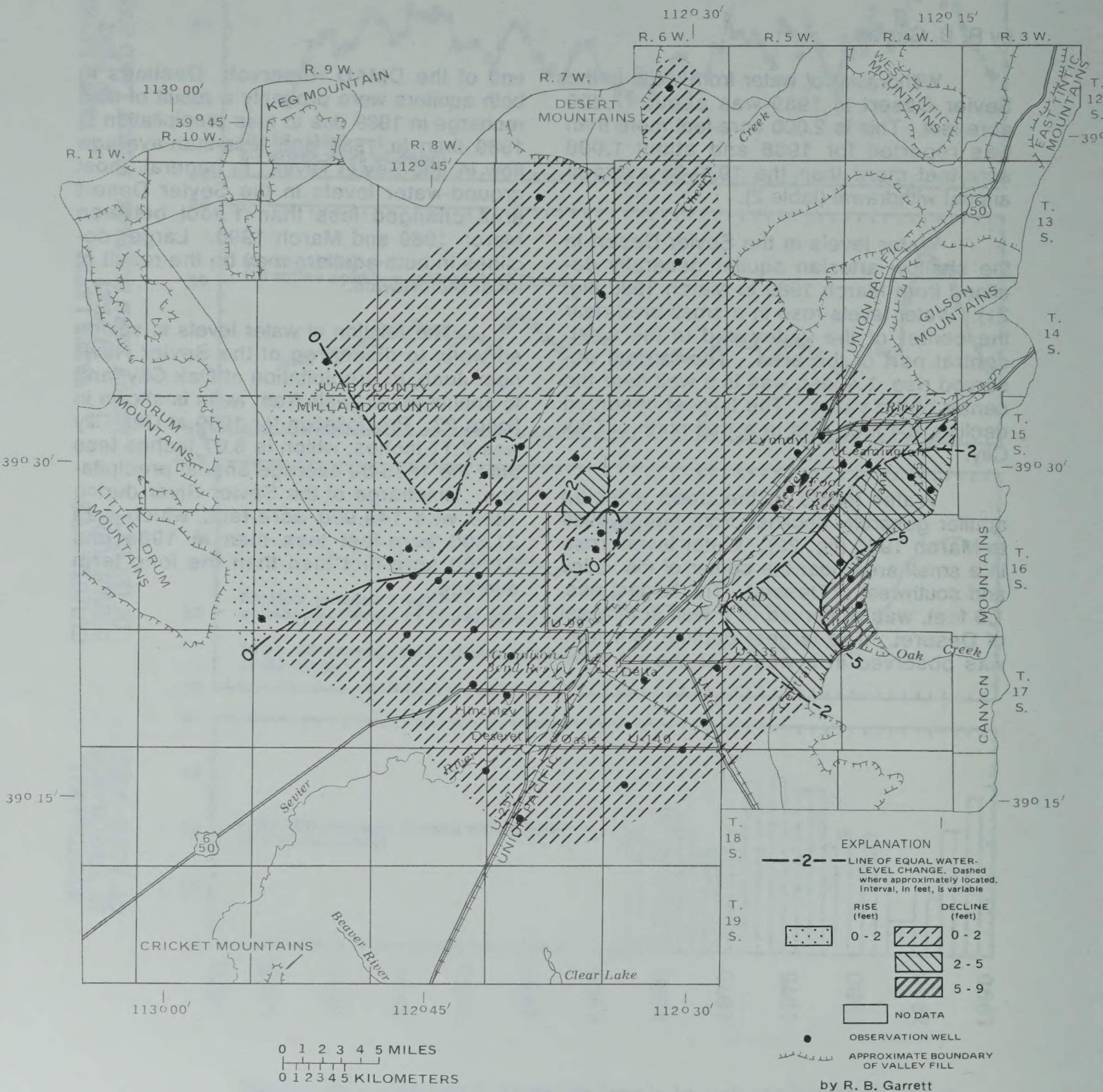


Figure 21.--Map of part of the Sevier Desert showing change of water levels in the shallow artesian aquifer from March 1989 to March 1990.

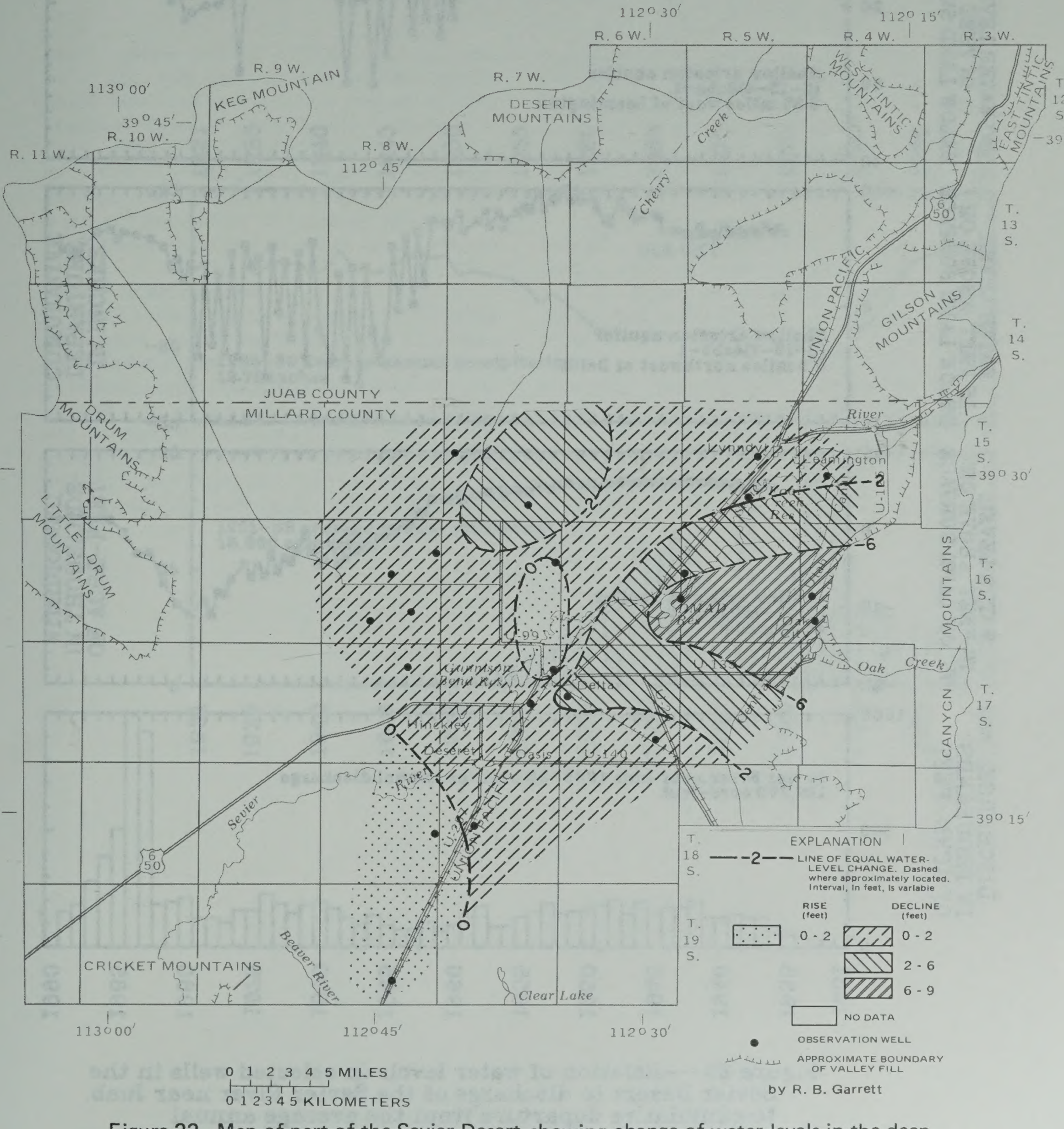


Figure 22.--Map of part of the Sevier Desert showing change of water levels in the deep artesian aquifer from March 1989 to March 1990.

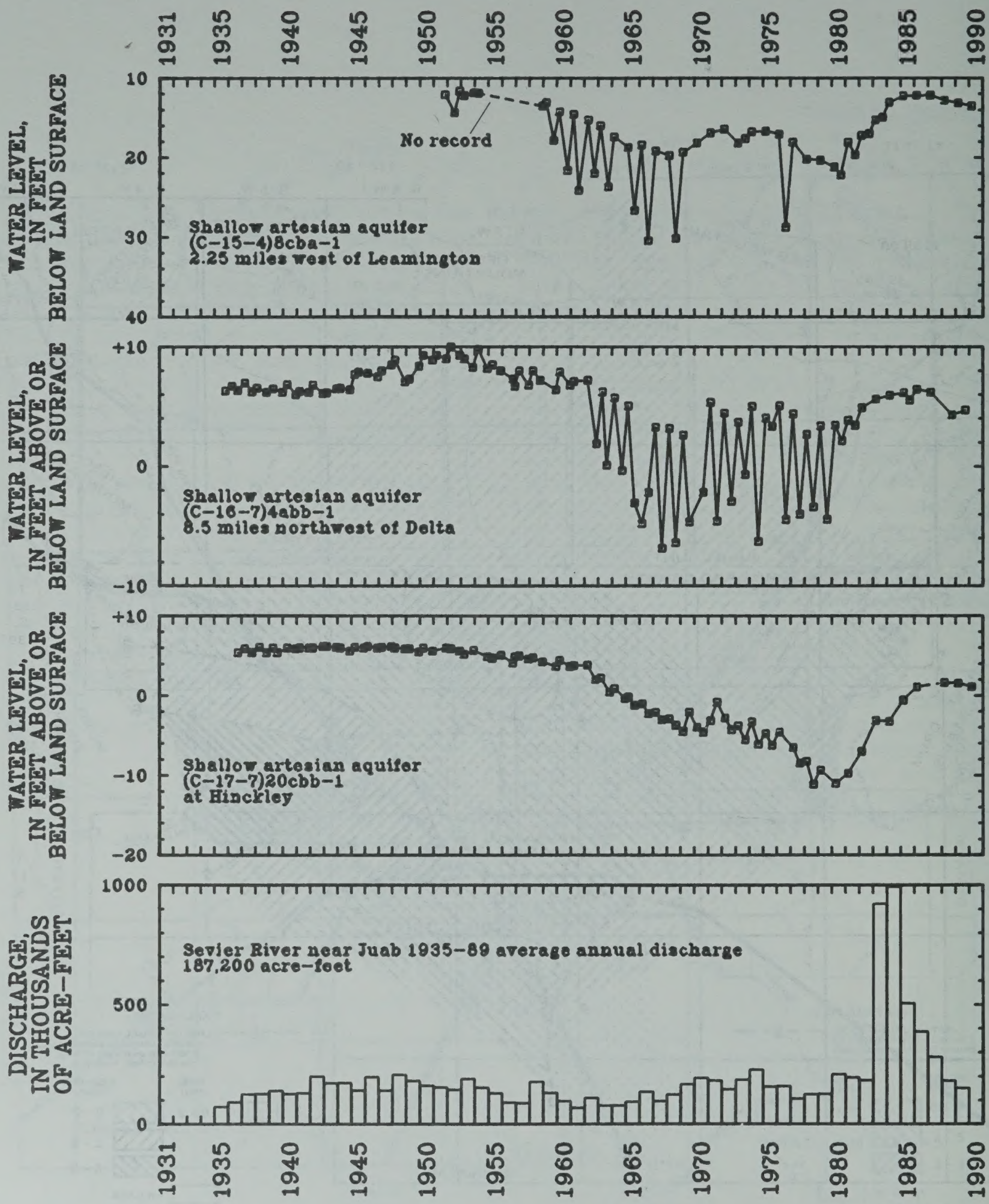


Figure 23.—Relation of water levels in selected wells in the Sevier Desert to discharge of the Sevier River near Juab, to cumulative departure from the average annual precipitation at Oak City, and to annual withdrawals from wells.

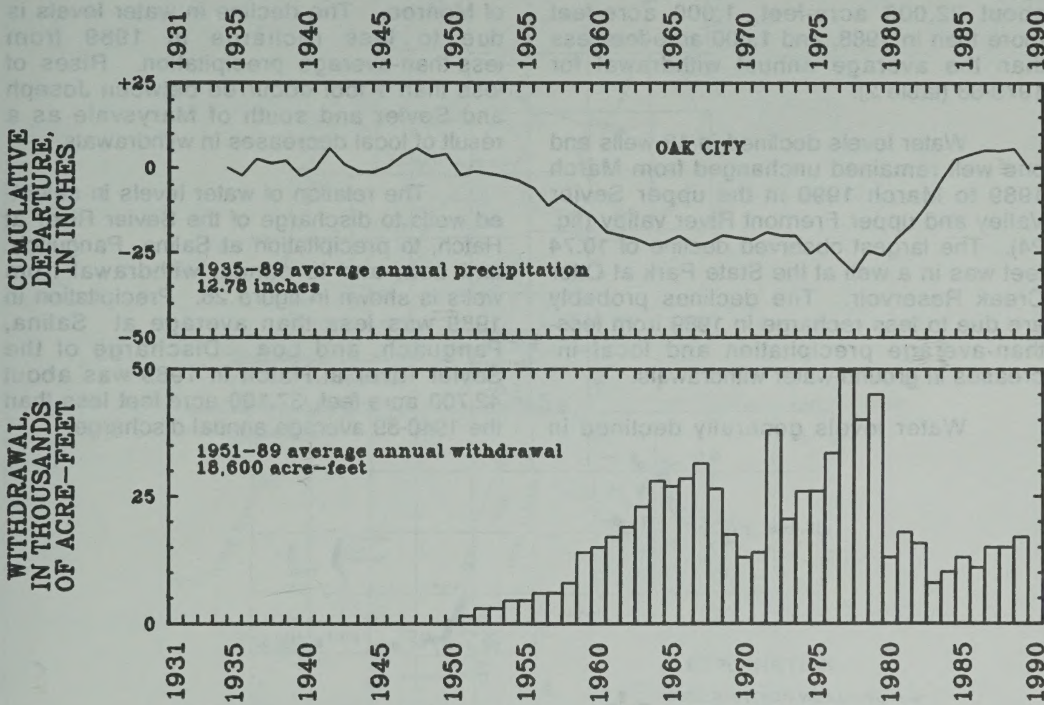


Figure 23.—Continued

UPPER AND CENTRAL SEVIER VALLEYS AND UPPER FREMONT RIVER VALLEY

by W.C. Brothers and R.W. Puchta

Withdrawal of water from wells in the upper and central Sevier Valleys and the upper Fremont River valley in 1989 was about 22,000 acre-feet, 1,000 acre-feet more than in 1988, and 1,000 acre-feet less than the average annual withdrawal for 1979-88 (table 2).

Water levels declined in 18 wells and one well remained unchanged from March 1989 to March 1990 in the upper Sevier Valley and upper Fremont River valley (fig. 24). The largest observed decline of 10.74 feet was in a well at the State Park at Otter Creek Reservoir. The declines probably are due to less recharge in 1989 from less-than-average precipitation and local increases in ground-water withdrawals.

Water levels generally declined in most of the central Sevier Valley from March 1989 to March 1990 (fig. 25). The largest decline was 6.0 feet in a well south of Monroe. The decline in water levels is due to less recharge in 1989 from less-than-average precipitation. Rises of less than 1 foot occurred between Joseph and Sevier and south of Marysvale as a result of local decreases in withdrawals.

The relation of water levels in selected wells to discharge of the Sevier River at Hatch, to precipitation at Salina, Panguitch, and Loa, and to annual withdrawal from wells is shown in figure 26. Precipitation in 1989 was less than average at Salina, Panguitch, and Loa. Discharge of the Sevier River at Hatch in 1989 was about 42,700 acre-feet, 37,100 acre-feet less than the 1940-89 average annual discharge.

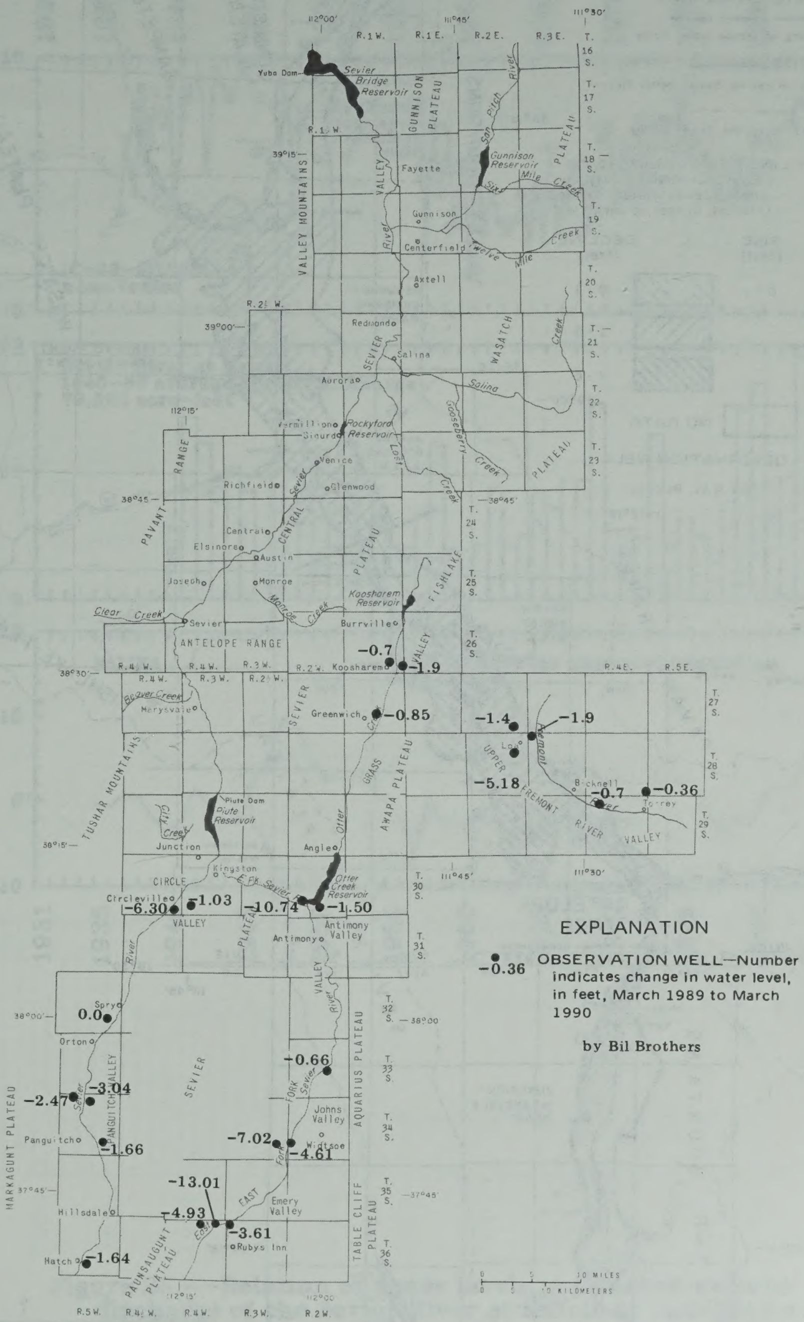


Figure 24.--Map of the upper Sevier Valley and the upper Fremont River valley showing change of water levels in selected wells from March 1989 to March 1990.

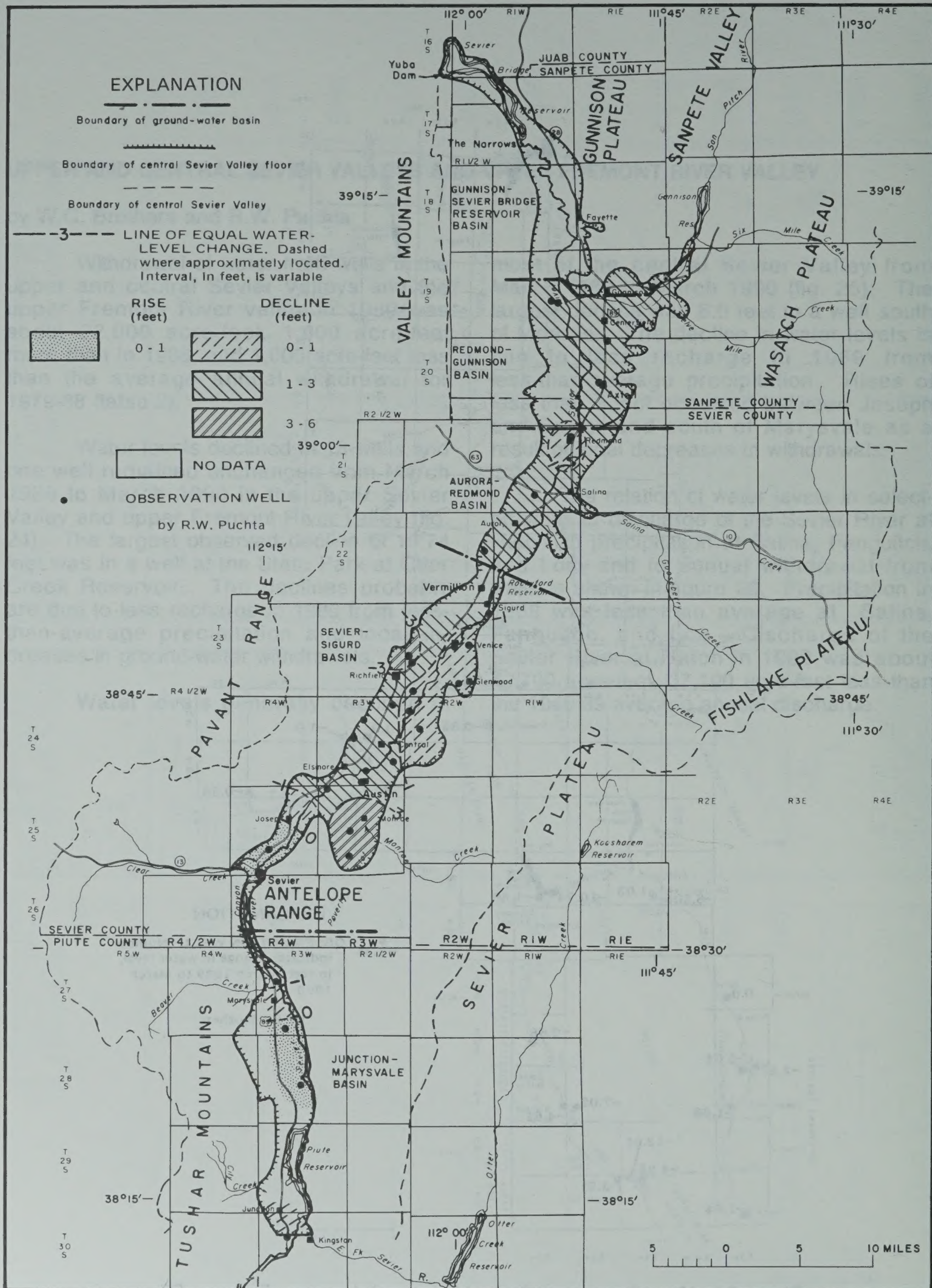


Figure 25.--Map of the central Sevier Valley showing change of water levels from March 1989 to March 1990.

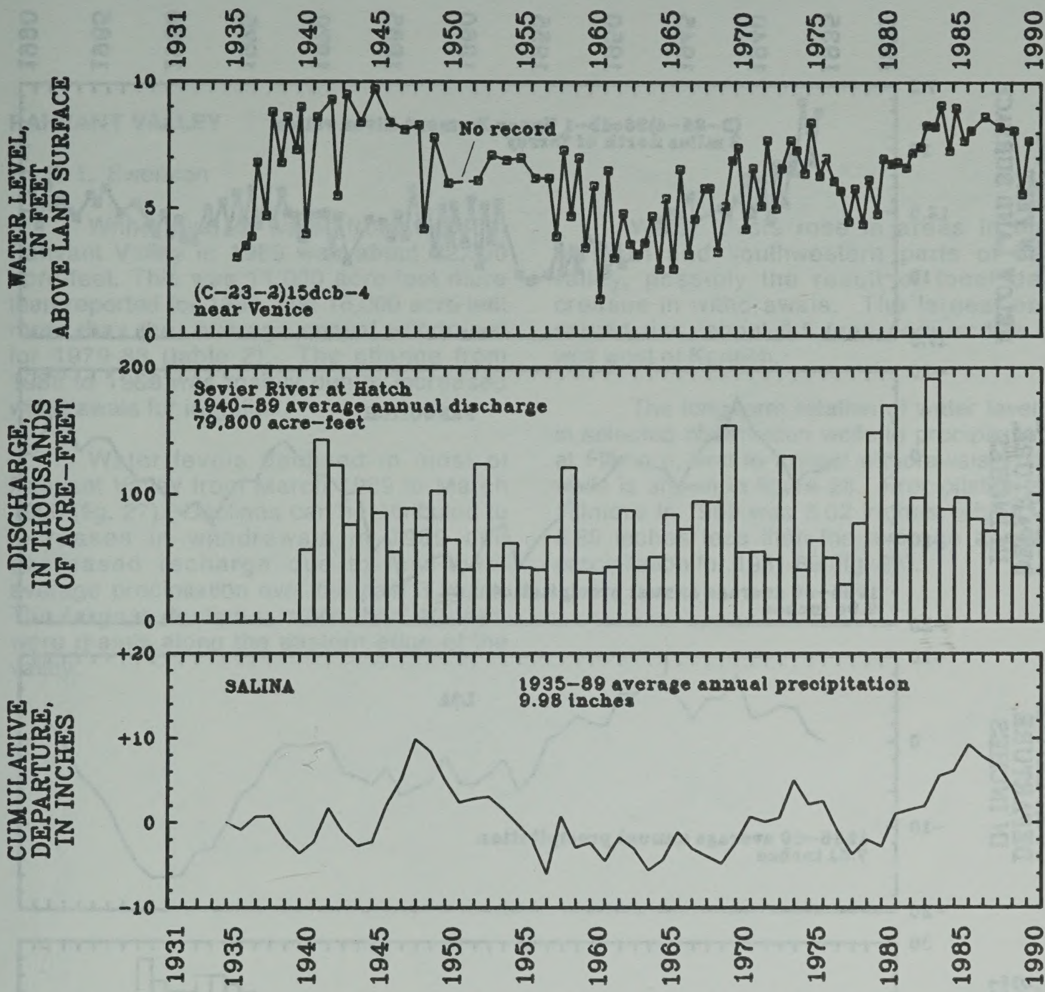


Figure 26.--Relation of water levels in selected wells to discharge of the Sevier River at Hatch, to cumulative departure from average annual precipitation at selected climate stations, and to annual withdrawal from wells--upper and central Sevier Valleys and upper Fremont River valley.

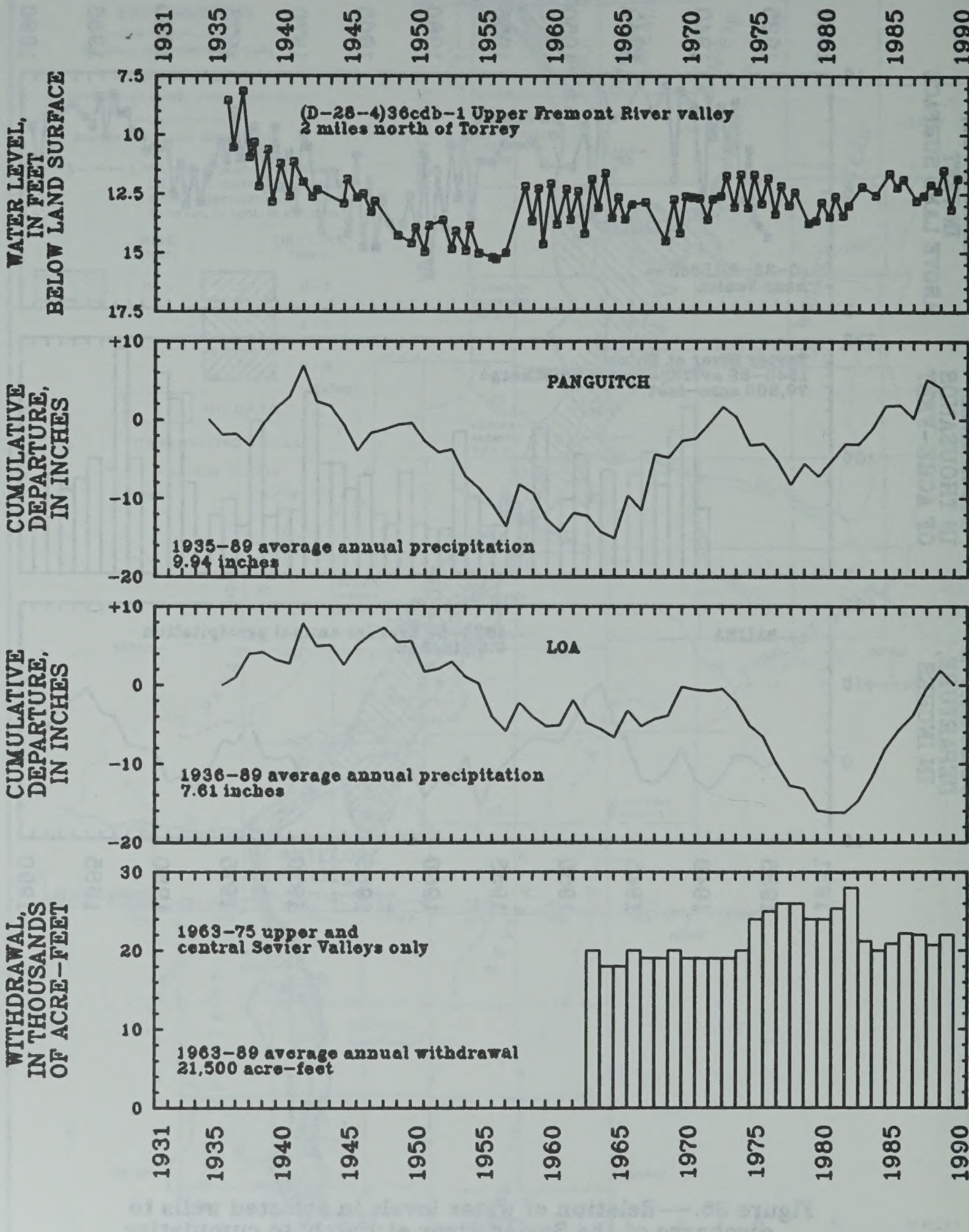


Figure 26.--Continued

PAHVANT VALLEY

By R. L. Swenson

Withdrawal of water from wells in Pahvant Valley in 1989 was about 82,000 acre-feet. This was 11,000 acre-feet more than reported for 1988, and 16,000 acre-feet more than the average annual withdrawal for 1979-88 (table 2). The change from 1988 to 1989 was mainly due to increased withdrawals for irrigation.

Water levels declined in most of Pahvant Valley from March 1989 to March 1990 (fig. 27). Declines can be attributed to increases in withdrawals in 1989 and decreased recharge due to less-than-average precipitation over the past 3 years. The largest declines, more than 10 feet, were mainly along the eastern edge of the valley.

Water levels rose in areas in the northern and southwestern parts of the valley, possibly the result of local decreases in withdrawals. The largest observed rise, about 4.5 feet, occurred in a well west of Kanosh.

The long-term relation of water levels in selected observation wells to precipitation at Fillmore, and to annual withdrawals from wells is shown in figure 28. Precipitation at Fillmore in 1989 was 8.02 inches, which is 6.89 inches less than the average annual precipitation for 1931-89 (fig. 28).

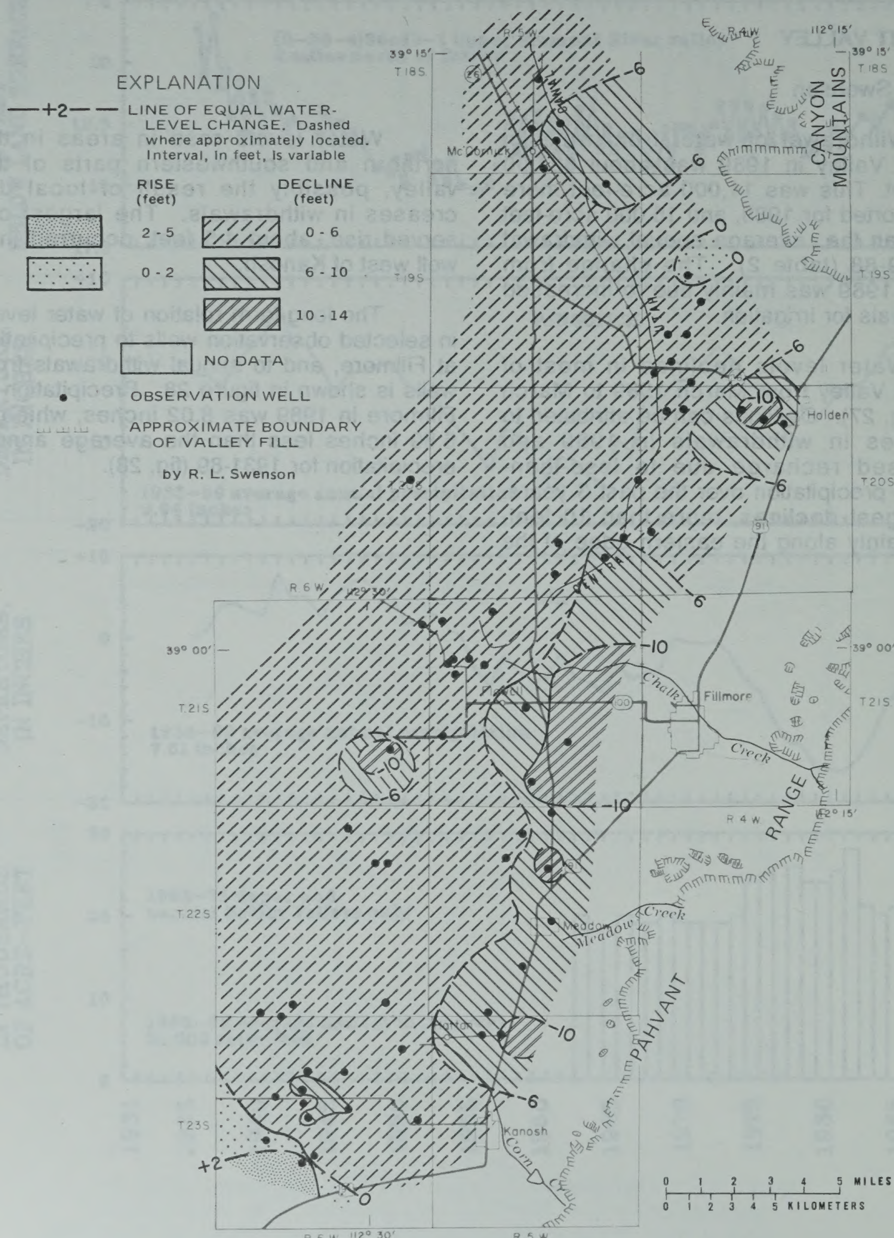


Figure 27.--Map of Pahvant Valley showing change of water levels from March 1989 to March 1990.

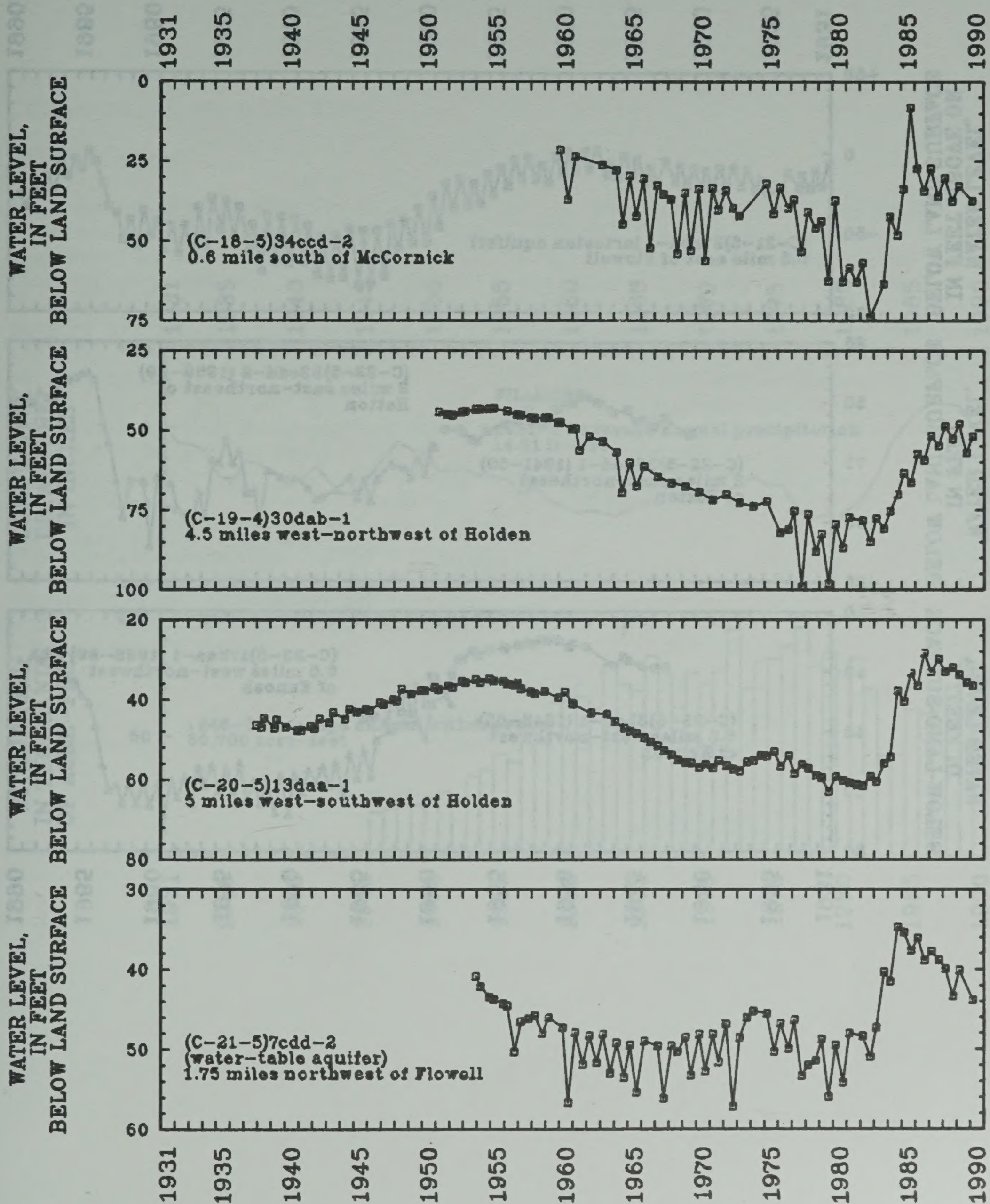


Figure 28.--Relation of water levels in selected wells in Pahvant Valley to cumulative departure from average annual precipitation at Fillmore and to annual withdrawals from wells.

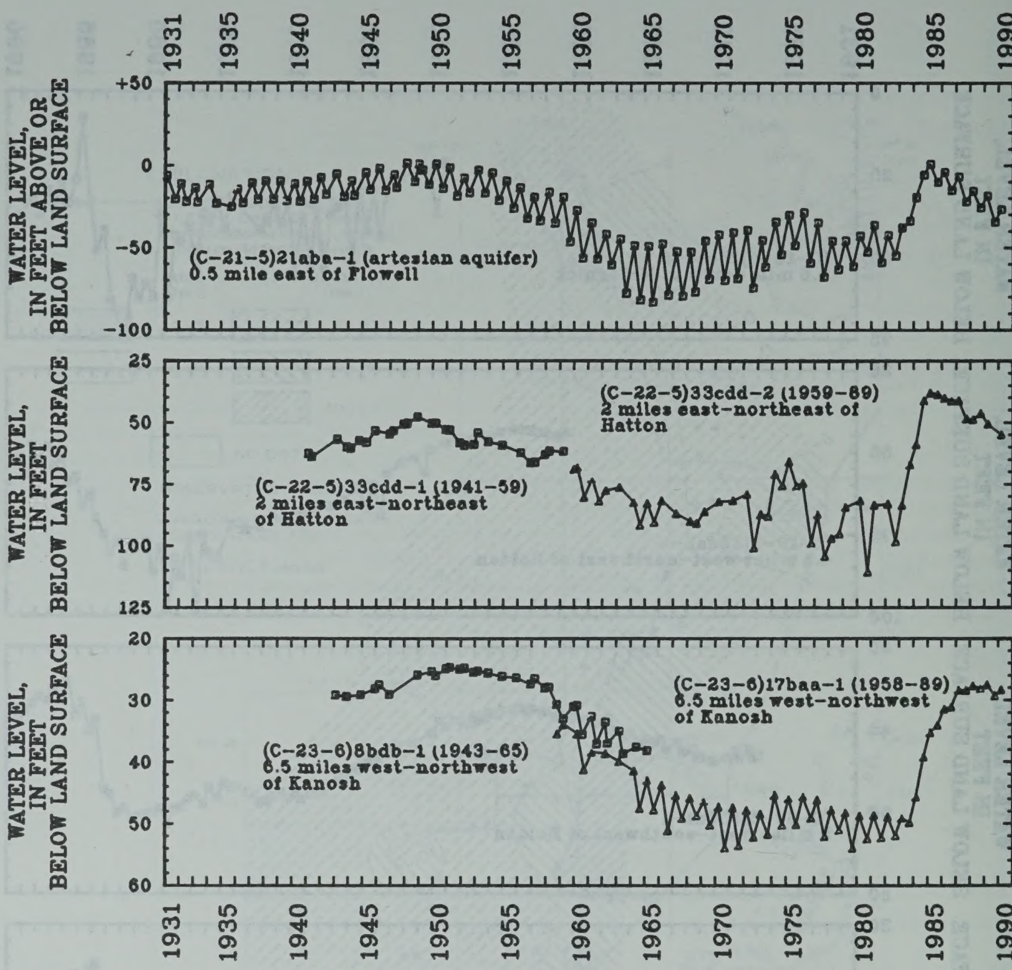


Figure 28.--Continued

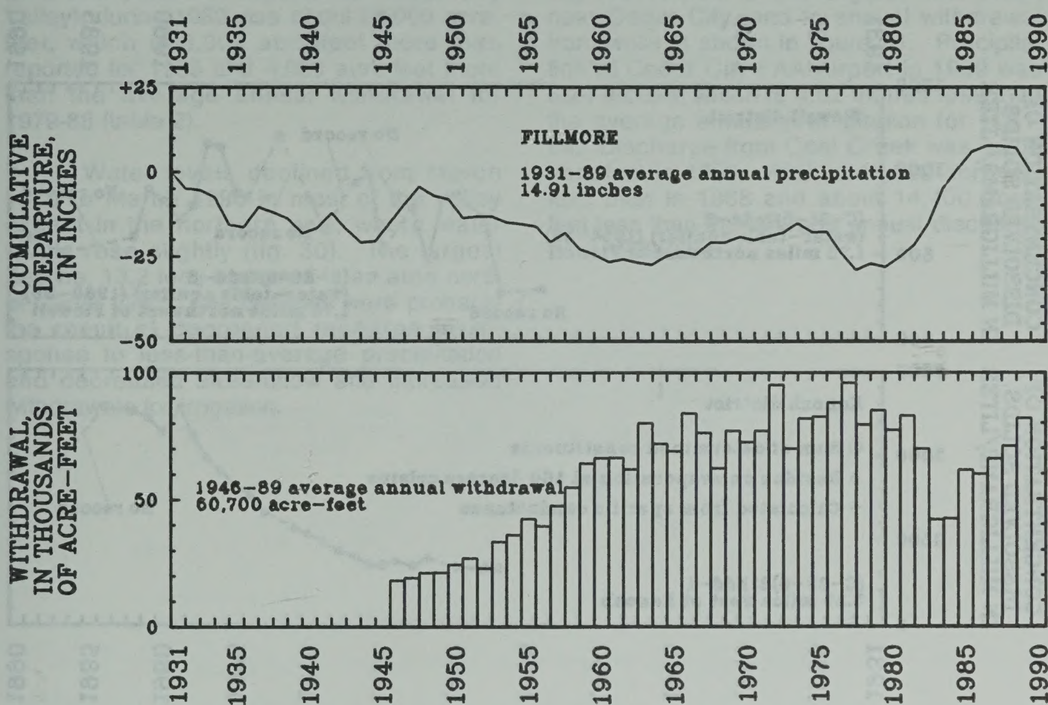


Figure 28.--Continued

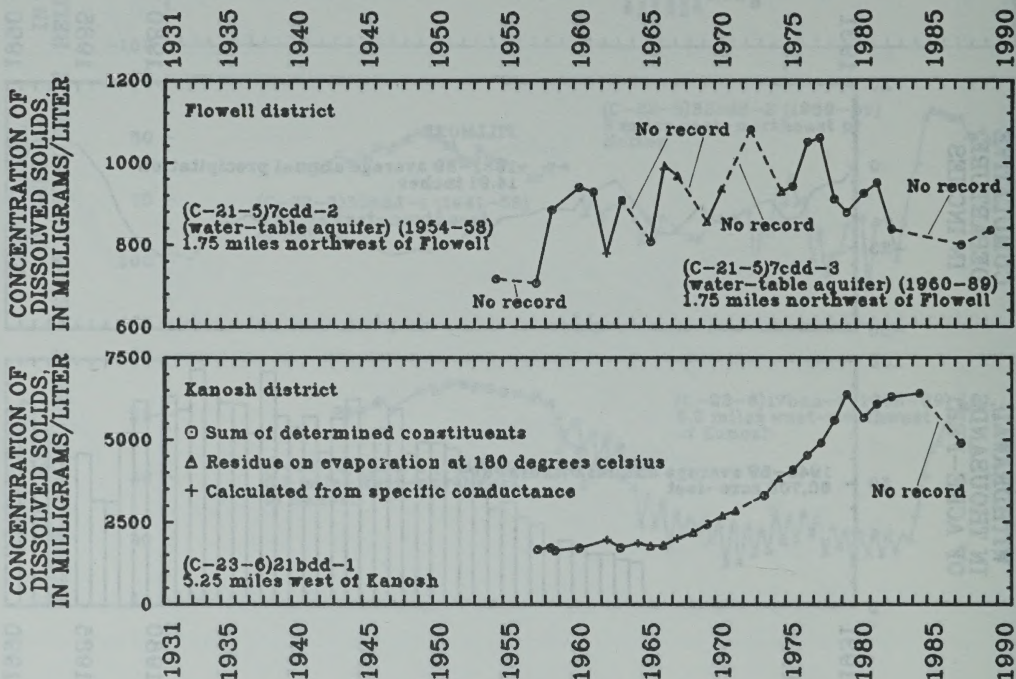


Figure 29.--Concentrations of dissolved solids in water from selected wells in Pahvant Valley.

CEDAR VALLEY, IRON COUNTY

by D. C. Emett

Withdrawal of water from wells in Cedar Valley, Iron County (formerly referred to in this series of reports as Cedar City Valley), during 1989 was about 28,000 acre-feet, which is 8,000 acre-feet more than reported for 1988 and 4,000 acre-feet more than the average annual withdrawal for 1979-88 (table 2).

Water levels declined from March 1989 to March 1990 in most of the valley except in the northern part, where water levels rose slightly (fig. 30). The largest decline, 13.2 feet, occurred in an area north of Cedar City. The declines were probably the result of decreased recharge in response to less-than-average precipitation and decreased streamflow and increased withdrawals for irrigation.

The relation of water levels in well (C-35-11)33aac-1 to precipitation at Cedar City FAA Airport, to discharge of Coal Creek near Cedar City, and to annual withdrawal from wells is shown in figure 31. Precipitation at Cedar City FAA Airport in 1989 was 6.24 inches, which is 4.52 inches less than the average annual precipitation for 1951-89. Discharge from Coal Creek was 9,700 acre-feet in 1989, which is 17,600 acre-feet less than in 1988 and about 14,400 acre-feet less than the average annual discharge from 1939-89.

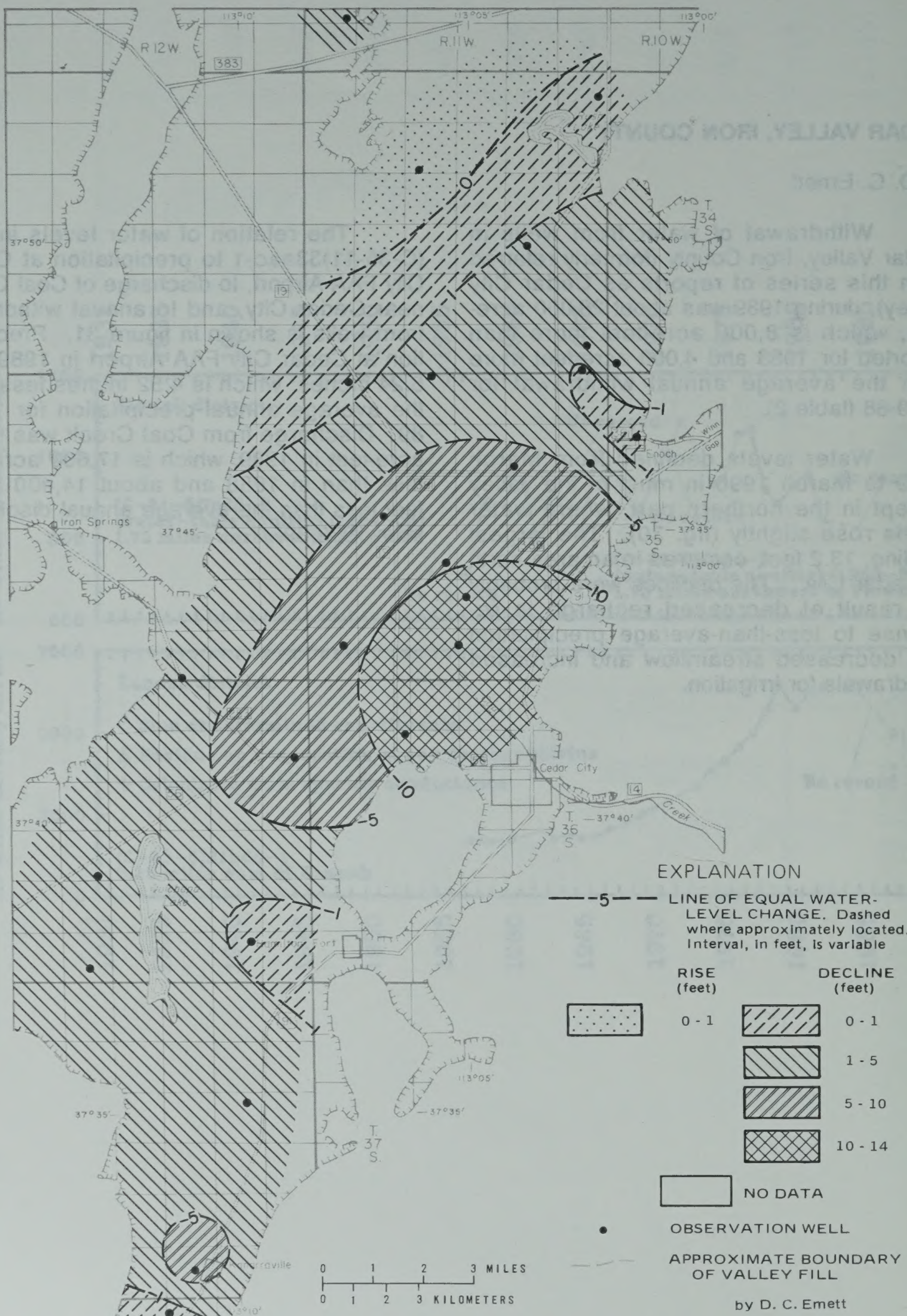


Figure 30.--Map of Cedar Valley, Iron County, showing change of water levels from March 1989 to March 1990.

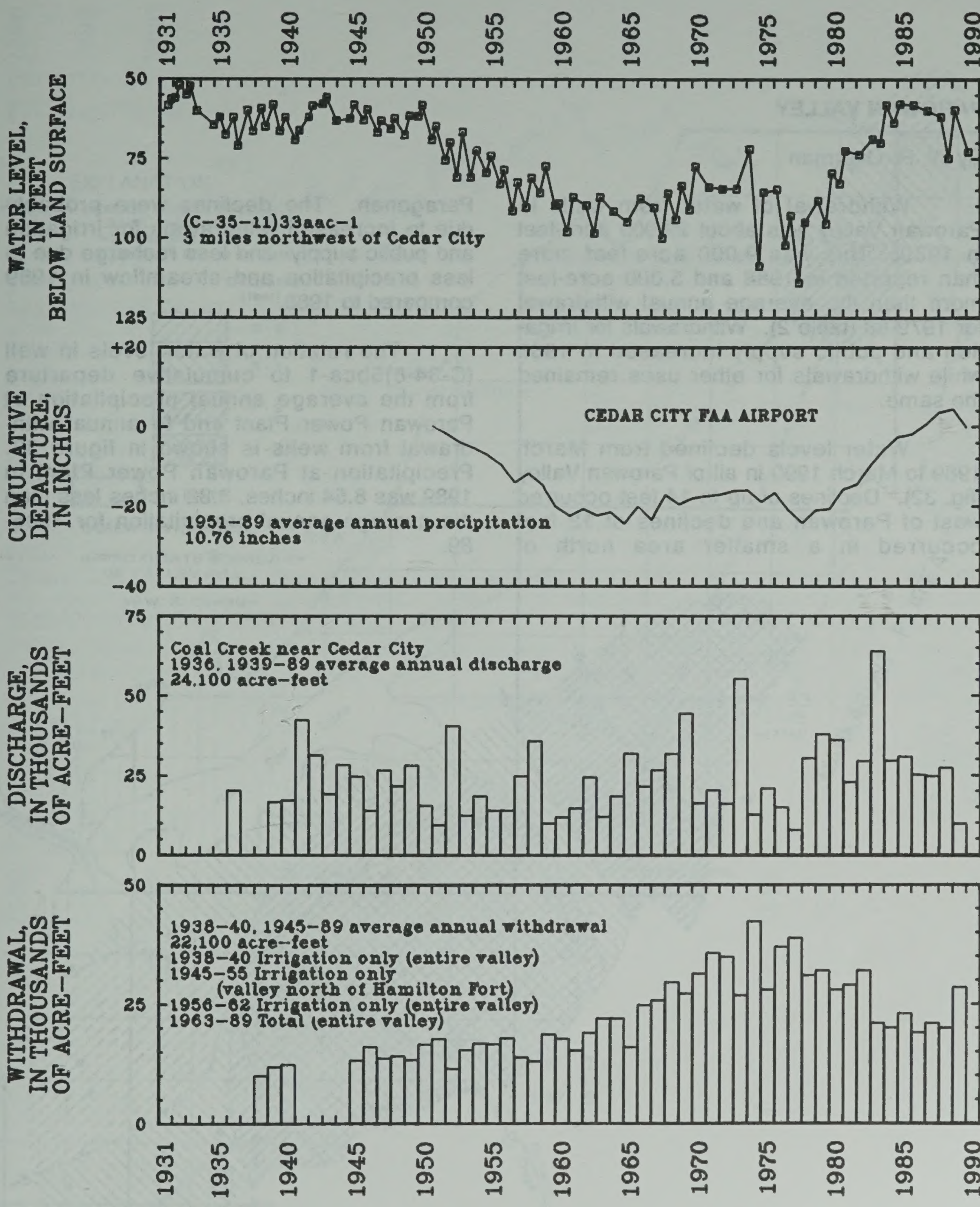


Figure 31.--Relation of water levels in well (C-35-11)33aac-1 in Cedar Valley, Iron County, to cumulative departure from the average annual precipitation at the Cedar City FAA Airport, to discharge of Coal Creek near Cedar City, and to annual withdrawals from wells.

PAROWAN VALLEY

By W. R. Overman

Withdrawal of water from wells in Parowan Valley was about 29,000 acre-feet in 1989. This was 9,000 acre-feet more than reported in 1988 and 5,000 acre-feet more than the average annual withdrawal for 1979-88 (table 2). Withdrawals for irrigation and public supply increased in 1989 while withdrawals for other uses remained the same.

Water levels declined from March 1989 to March 1990 in all of Parowan Valley (fig. 32). Declines of up to 14 feet occurred west of Parowan and declines of 12 feet occurred in a smaller area north of Paragonah. The declines were probably due to increased withdrawals for irrigation and public supply and less recharge due to less precipitation and streamflow in 1989 compared to 1988.

The relation of water levels in well (C-34-8)5bca-1 to cumulative departure from the average annual precipitation at Parowan Power Plant and to annual withdrawal from wells is shown in figure 33. Precipitation at Parowan Power Plant in 1989 was 8.54 inches, 3.82 inches less than the average annual precipitation for 1935-89.

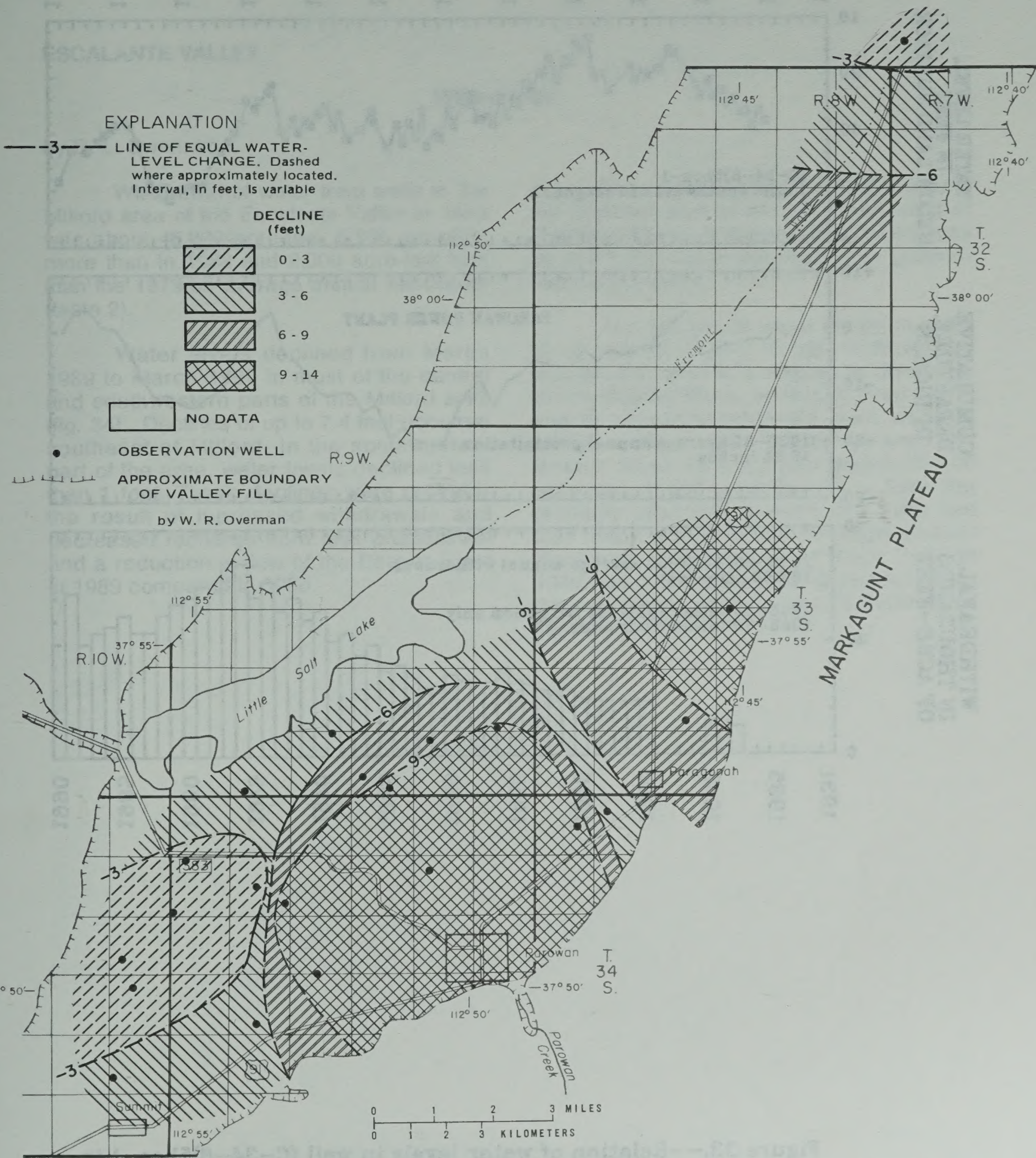


Figure 32.--Map of Parowan Valley showing change of water levels from March 1989 to March 1990.

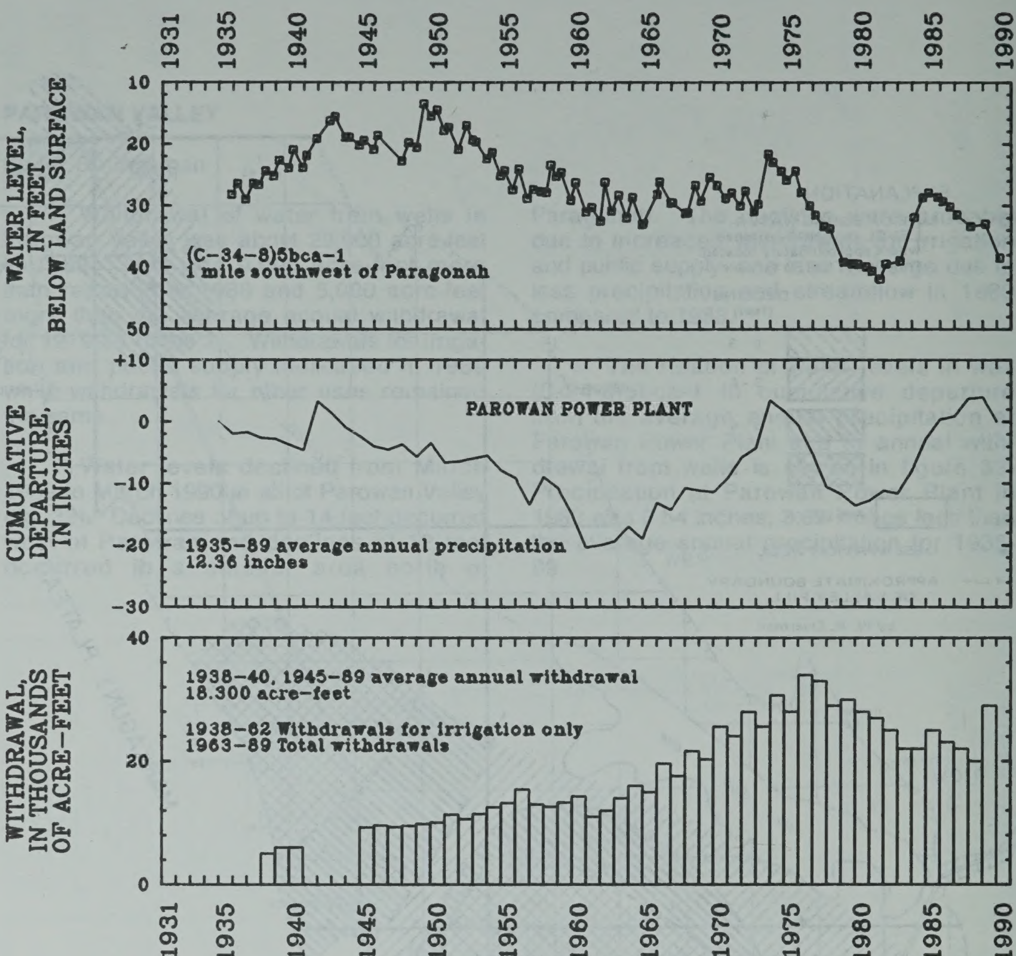


Figure 33.--Relation of water levels in well (C-34-8)5bca-1 in Parowan Valley to cumulative departure from the average annual precipitation at Parowan Power Plant and to annual withdrawals from wells.

ESCALANTE VALLEY

Milford area

by R. L. Swenson

Withdrawal of water from wells in the Milford area of the Escalante Valley in 1989 was about 46,000 acre-feet, 6,000 acre-feet more than in 1988 and 2,000 acre-feet less than the 1979-88 average annual withdrawal (table 2).

Water levels declined from March 1989 to March 1990 in most of the central and southwestern parts of the Milford area (fig. 34). Declines of up to 7.4 feet occurred southeast of Milford. In the southwestern part of the area, water levels declined less than 1 foot. These declines were probably the result of increased withdrawals and decreased recharge from less precipitation and a reduction in flow of the Beaver River in 1989 compared to 1988.

Rises of less than 1 foot occurred in the northern part of the area and west of Thermo Siding. Rises in water levels may be related to local decreases in ground-water withdrawals.

The relation of water levels in wells (C-29-10)6ddc-1 and (C-29-11)13add-1 to precipitation at Milford Airport, to discharge of the Beaver River at Rocky Ford Dam, and to annual withdrawals from wells is shown in figure 35. Discharge from the Beaver River in 1989 was about 23,100 acre-feet, 6,800 acre-feet less than the previous year and about 6,800 acre-feet less than the 1931-89 average annual discharge. Precipitation at Black Rock in 1989 was 4.23 inches, 4.64 inches less than the average annual precipitation for 1952-89.

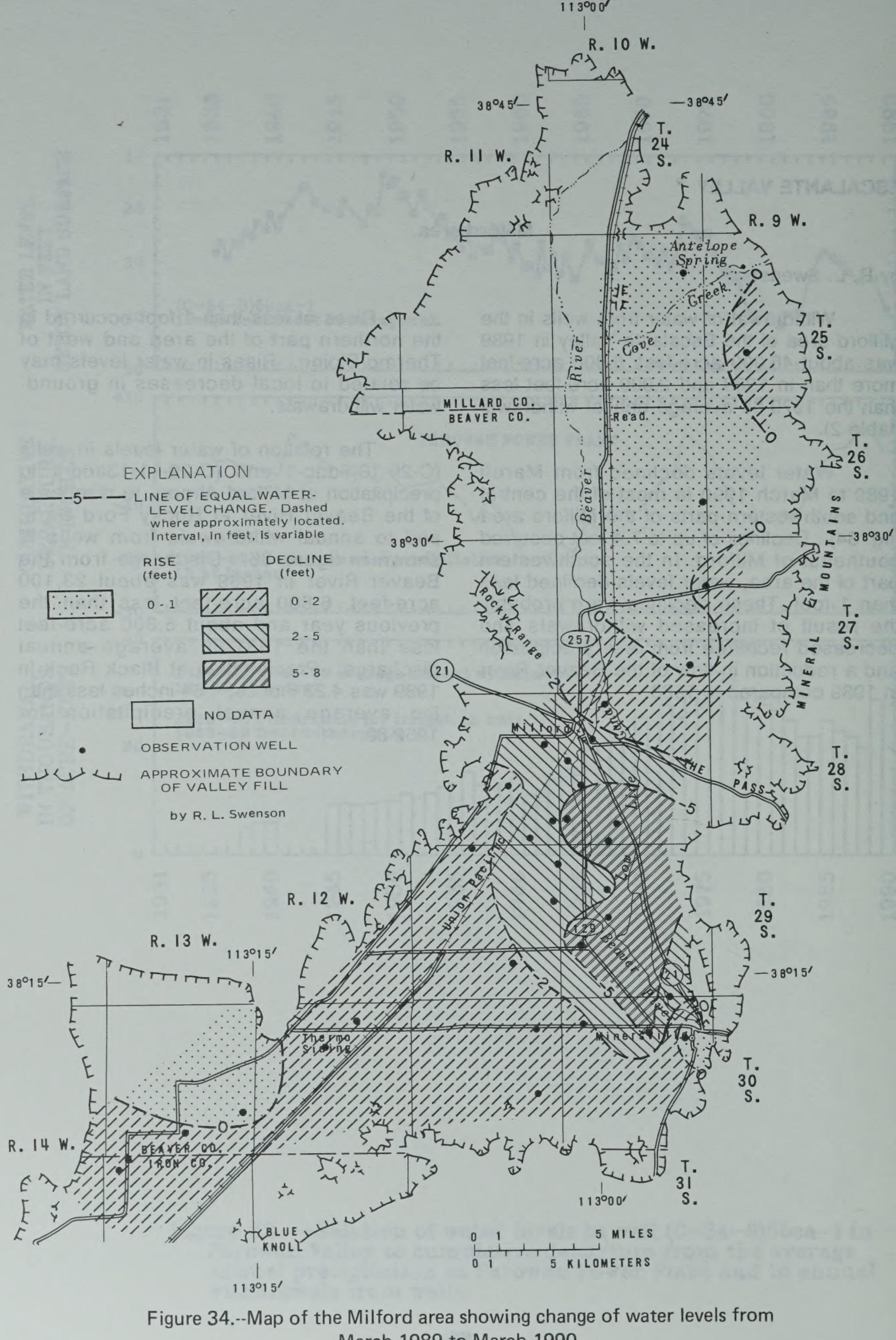


Figure 34.--Map of the Milford area showing change of water levels from March 1989 to March 1990.

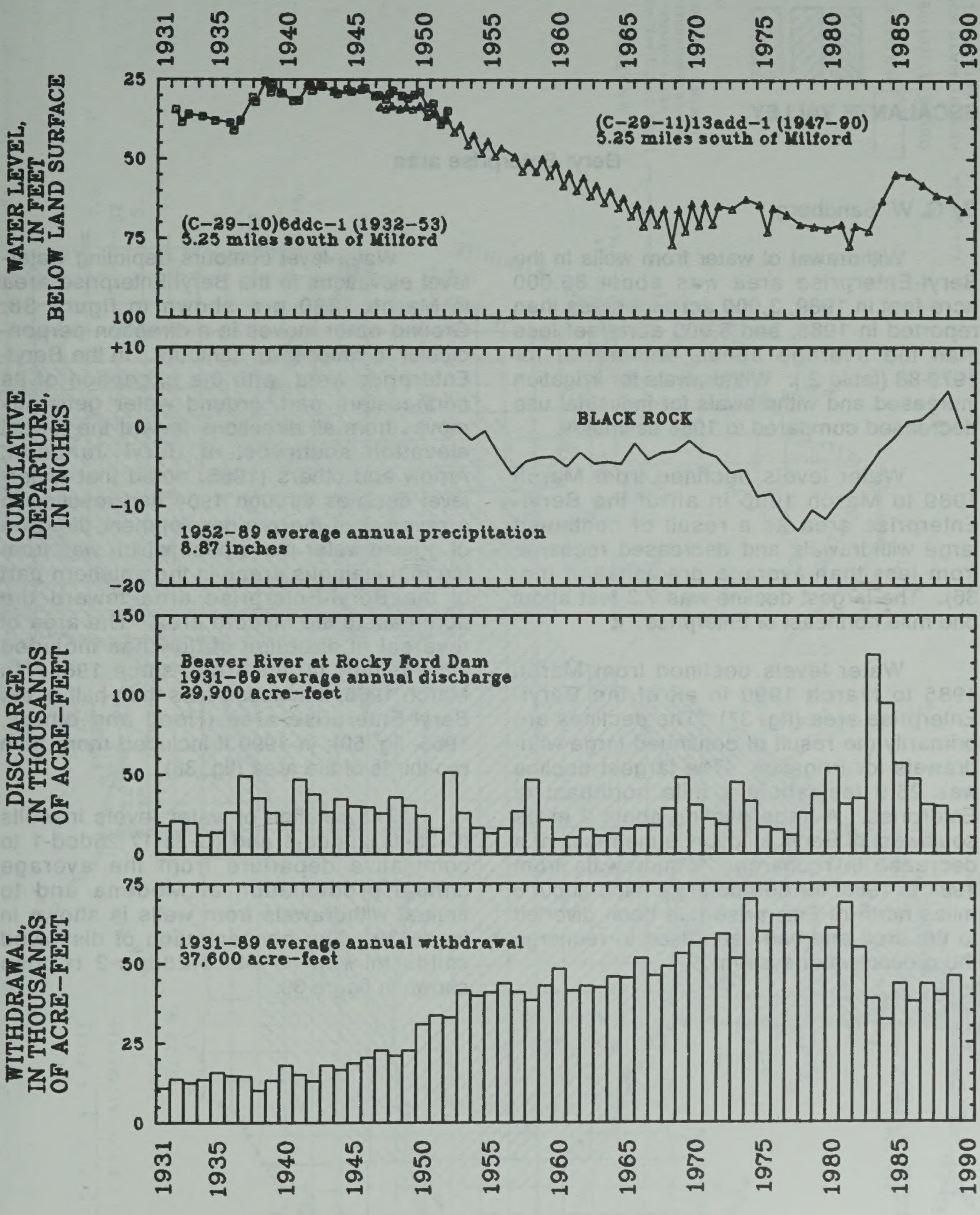


Figure 35.--Relation of water levels in wells (C-29-10)6ddc-1 and (C-29-11)13add-1 in the Milford area to cumulative departure from the average annual precipitation at Milford Airport, to discharge of the Beaver River at Rocky Ford Dam, and to annual withdrawals from wells.

ESCALANTE VALLEY

Beryl-Enterprise area

By G. W. Sandberg

Withdrawal of water from wells in the Beryl-Enterprise area was about 85,000 acre-feet in 1989, 3,000 acre-feet less than reported in 1988, and 5,000 acre-feet less than the average annual withdrawal for 1979-88 (table 2). Withdrawals for irrigation increased and withdrawals for industrial use decreased compared to 1988 estimates.

Water levels declined from March 1989 to March 1990 in all of the Beryl-Enterprise area as a result of continued large withdrawals and decreased recharge from less-than-average precipitation (fig. 36). The largest decline was 7.3 feet about one mile northeast of Enterprise.

Water levels declined from March 1985 to March 1990 in all of the Beryl-Enterprise area (fig. 37). The declines are primarily the result of continued large withdrawals for irrigation. The largest decline was 26.9 feet about 1 mile northeast of Enterprise. A large decline about 2 miles southwest of Beryl Junction is the result of a decrease in recharge. Withdrawals from 1981 to 1988 for dewatering a mine about 6 miles north of Enterprise had been diverted to the area and had been used to recharge the ground-water system.

Water-level contours depicting water-level elevations in the Beryl-Enterprise area in March 1990 are shown in figure 38. Ground water moves in a direction perpendicular to water-level contours. In the Beryl-Enterprise area, with the exception of its northeastern part, ground water generally moves from all directions toward the lowest elevation southwest of Beryl Junction. Arnow and others (1965) noted that water-level declines through 1964 had resulted in a reversal of the pre-development direction of ground-water movement, which was from the mountainous areas in the southern part of the Beryl-Enterprise area toward the northeast to the Mildord area. The area of reversal of direction of flow has included increasingly larger areas since 1965. In March 1966, it included less than half of the Beryl-Enterprise area (Hood and others, 1966, fig. 50); in 1990 it included more than two-thirds of the area (fig. 38).

The relation of water levels in wells (C-35-17)25cdd-1 and (C-35-17)25dcd-1 to cumulative departure from the average annual precipitation at Modena and to annual withdrawals from wells is shown in figure 39. The concentration of dissolved solids in well (C-34-16)28dcc-2 is also shown in figure 39.

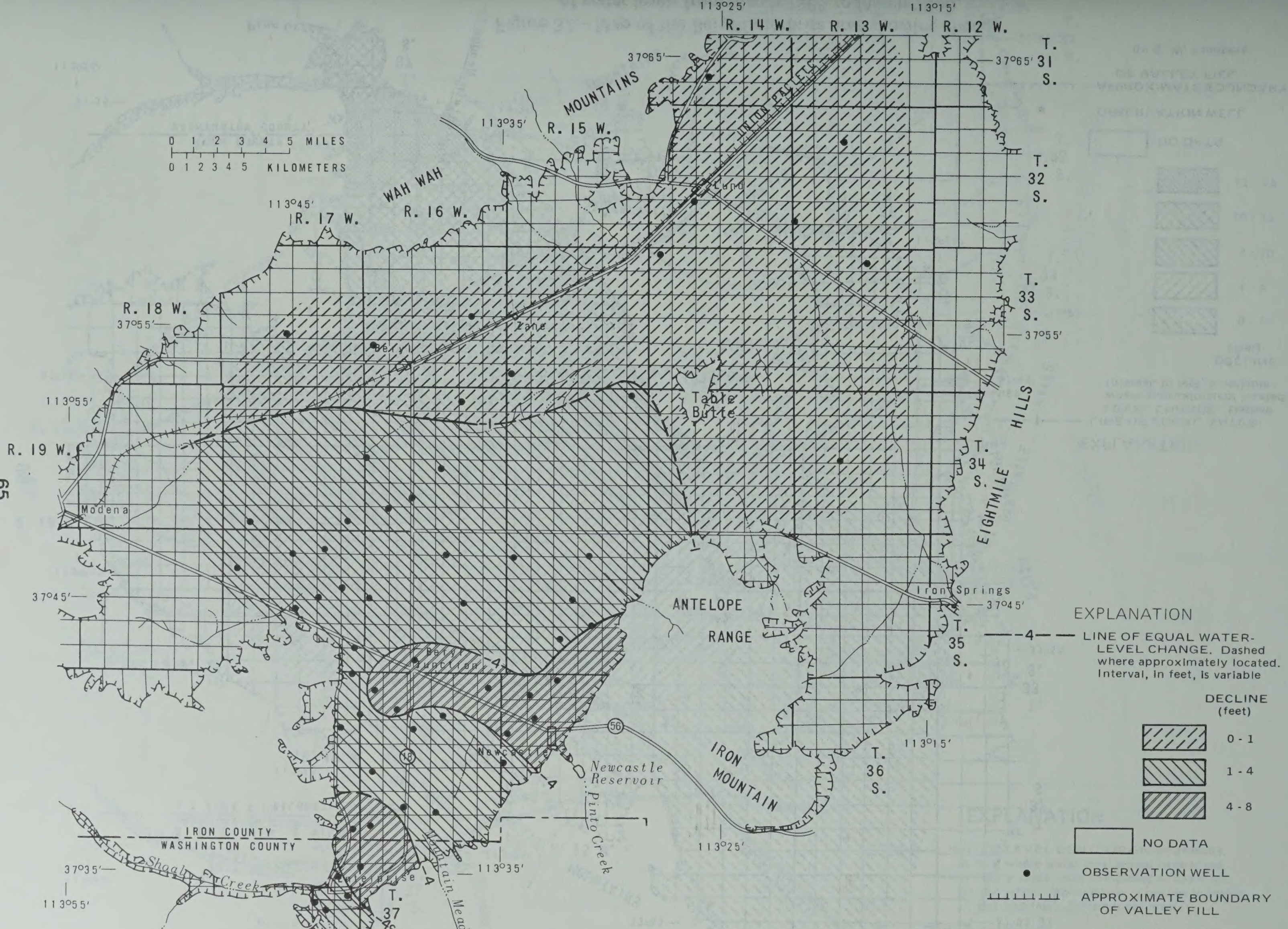


Figure 36.--Map of the Beryl-Enterprise area showing change of water levels from March 1989 to March 1990.

Figure 37.-- Map of the Beryl-Enterprise area showing change of water levels from March 1985 to March 1990.

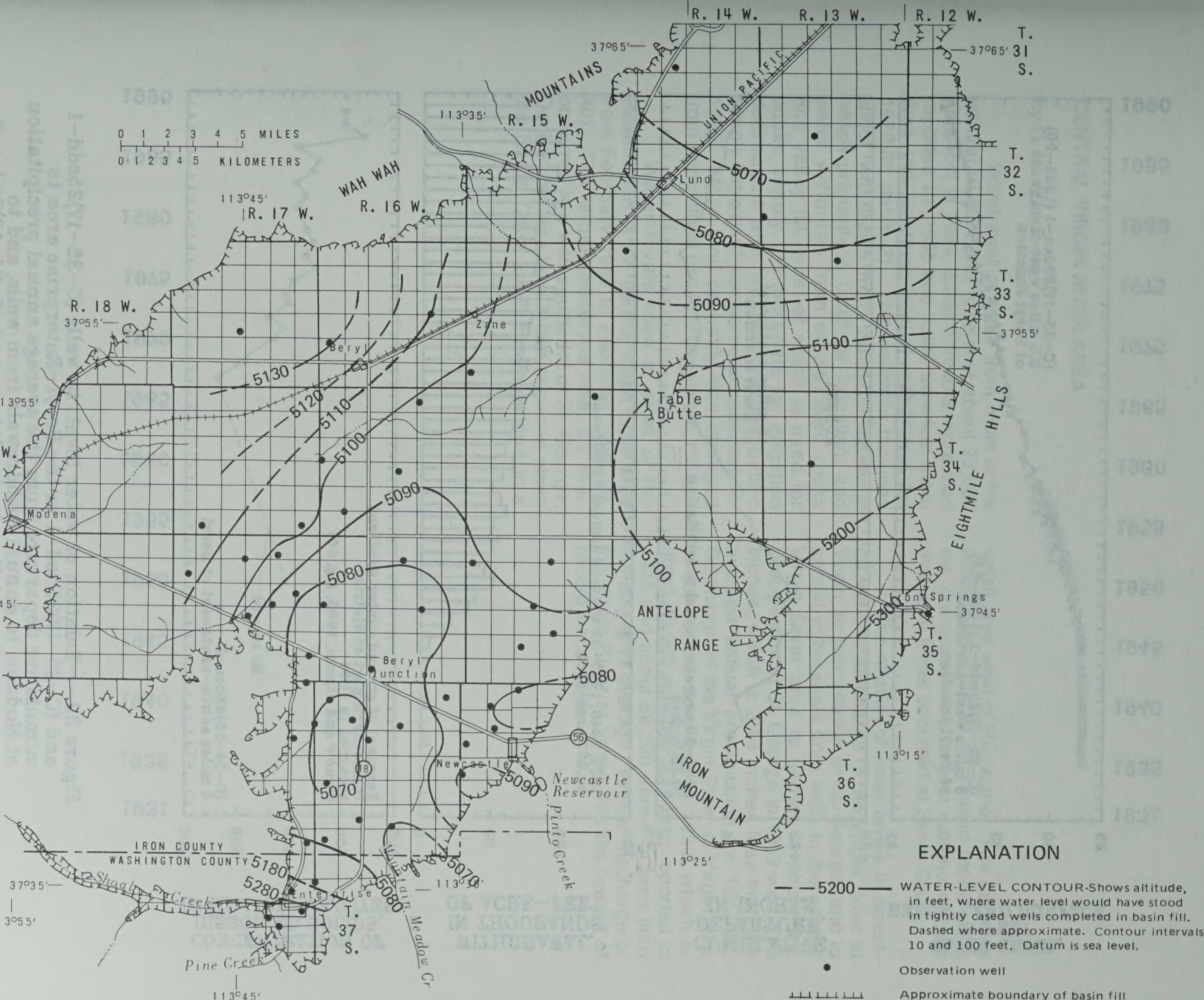


Figure 38.--Map of Beryl-Enterprise area showing water-level contours, March 1990.

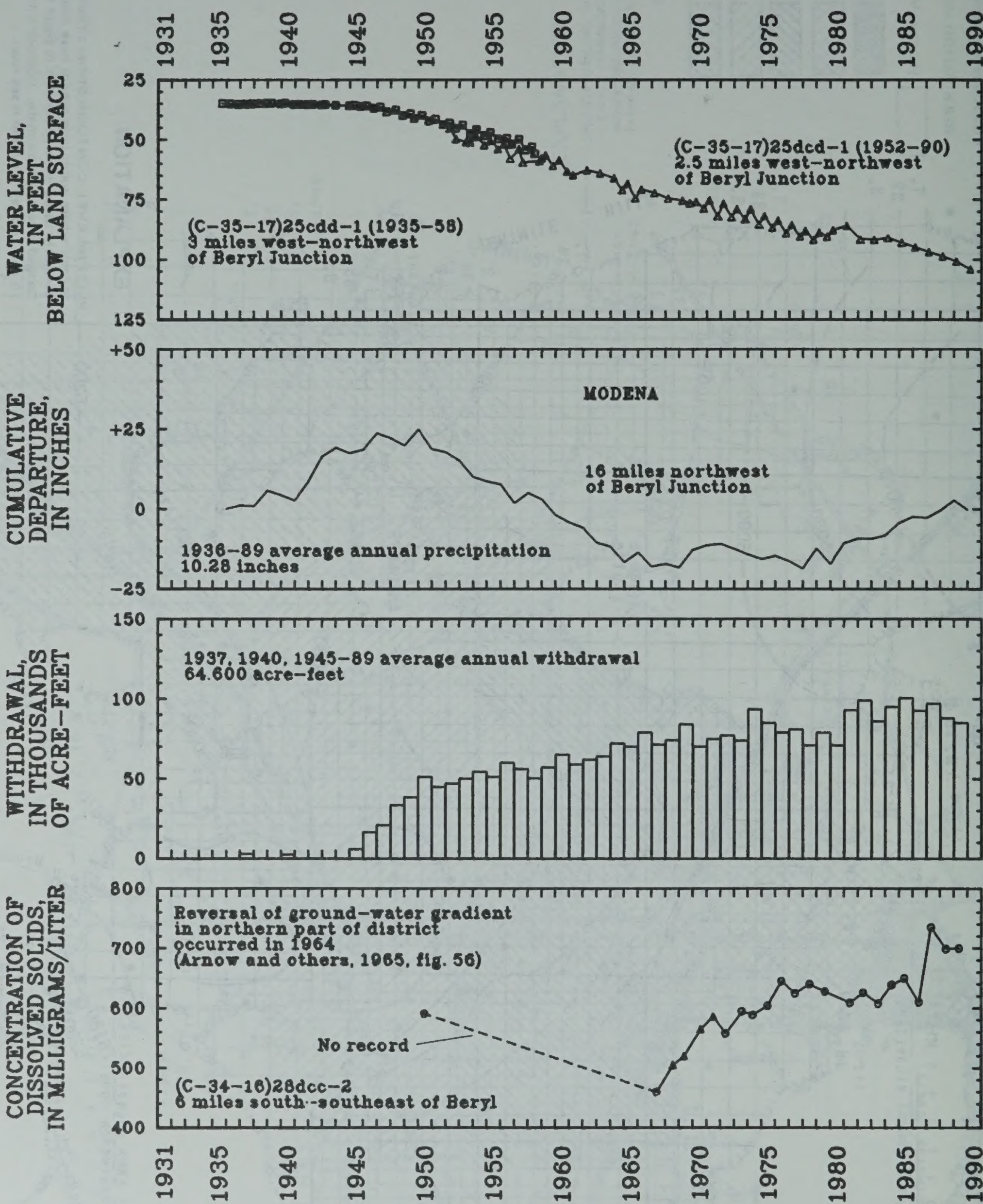


Figure 39.--Relation of water levels in wells (C-35-17)25cdd-1 and (C-35-17)25dcd-1 in the Beryl-Enterprise area to cumulative departure from the average annual precipitation at Modena, to annual withdrawals from wells, and to concentration of dissolved solids in well (C-34-16)28dcc-2.

CENTRAL VIRGIN RIVER AREA

by G. W. Sandberg

Withdrawal of water from wells in the central Virgin River area was about 23,000 acre-feet in 1989, 5,000 acre-feet more than reported for 1988 and 3,000 acre-feet more than the average annual withdrawal for 1979-88 (table 2). This estimate includes water withdrawn from valley-fill aquifers, which primarily is used for irrigation, and water withdrawn from consolidated rocks and valley fill, most of which is used for public supply. Withdrawals for irrigation decreased and withdrawals for public supply increased compared to estimates for 1988. More land probably was changed from agricultural use to urban use in 1989.

Water levels rose in most of the eastern part of the central Virgin River area from February 1989 to February 1990 (fig. 40). The largest observed rise, 3.2 feet, occurred in a well southeast of St. George. Declines of less than 3 feet occurred along the Santa Clara River drainage and in a small area west of Hurricane. The declines probably are due to decreased recharge in the drainage. The largest decline of less than than 9 feet occurred at Santa Clara.

The relation of water levels in selected wells to discharge of the Virgin River at Virgin, to precipitation at St. George, and to annual withdrawals from wells in the central Virgin River area is shown in figure 41. Precipitation at St. George in 1989 was 4.73 inches, which is 3.18 inches less than the average annual precipitation for 1947-89. Discharge of the Virgin River at Virgin was about 76,700 acre-feet in 1989, which is about 43,900 acre-feet less than reported in 1988 and about 59,200 acre-feet less than the long-term average. Annual discharge of the Virgin River at Virgin was the lowest of record since 1956.

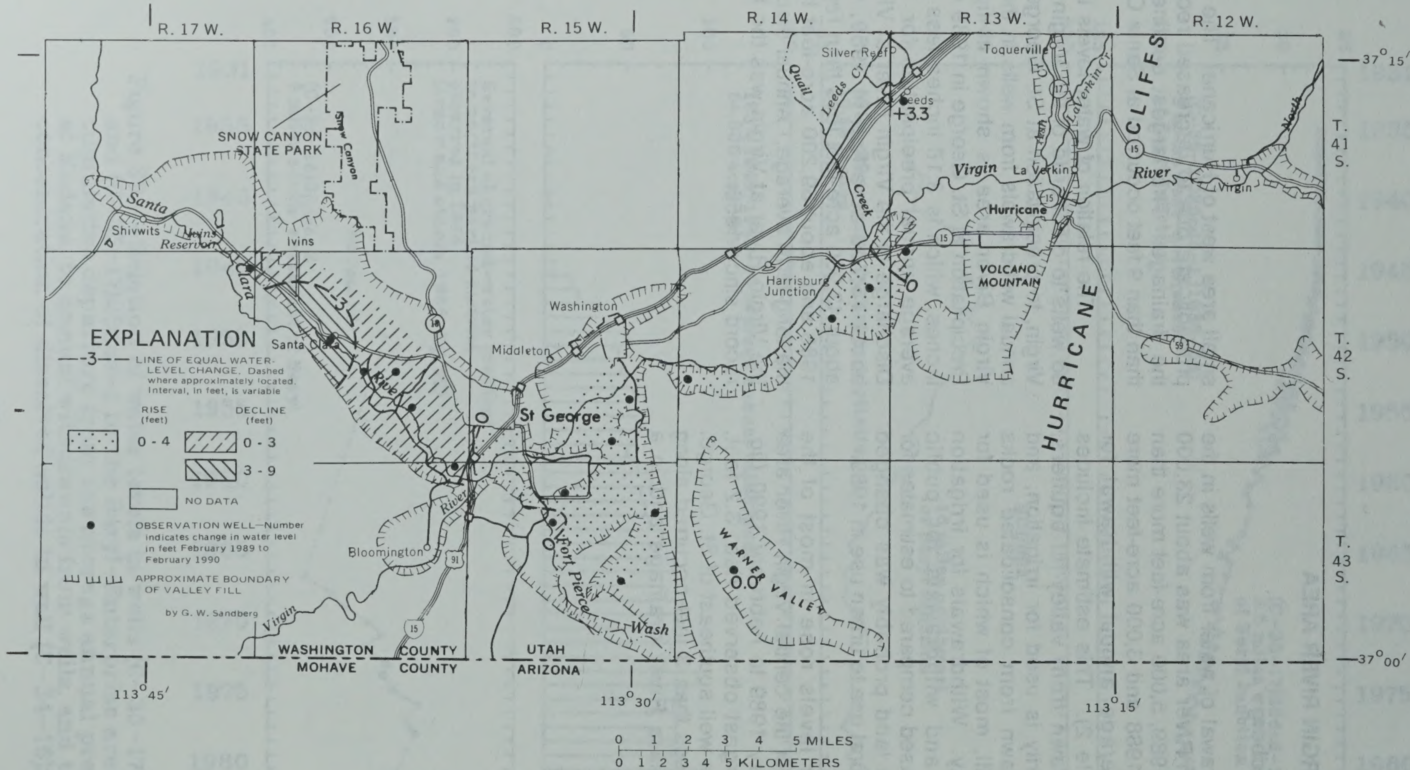


Figure 40.--Map of the central Virgin River area showing change of water levels from February 1989 to February 1990.

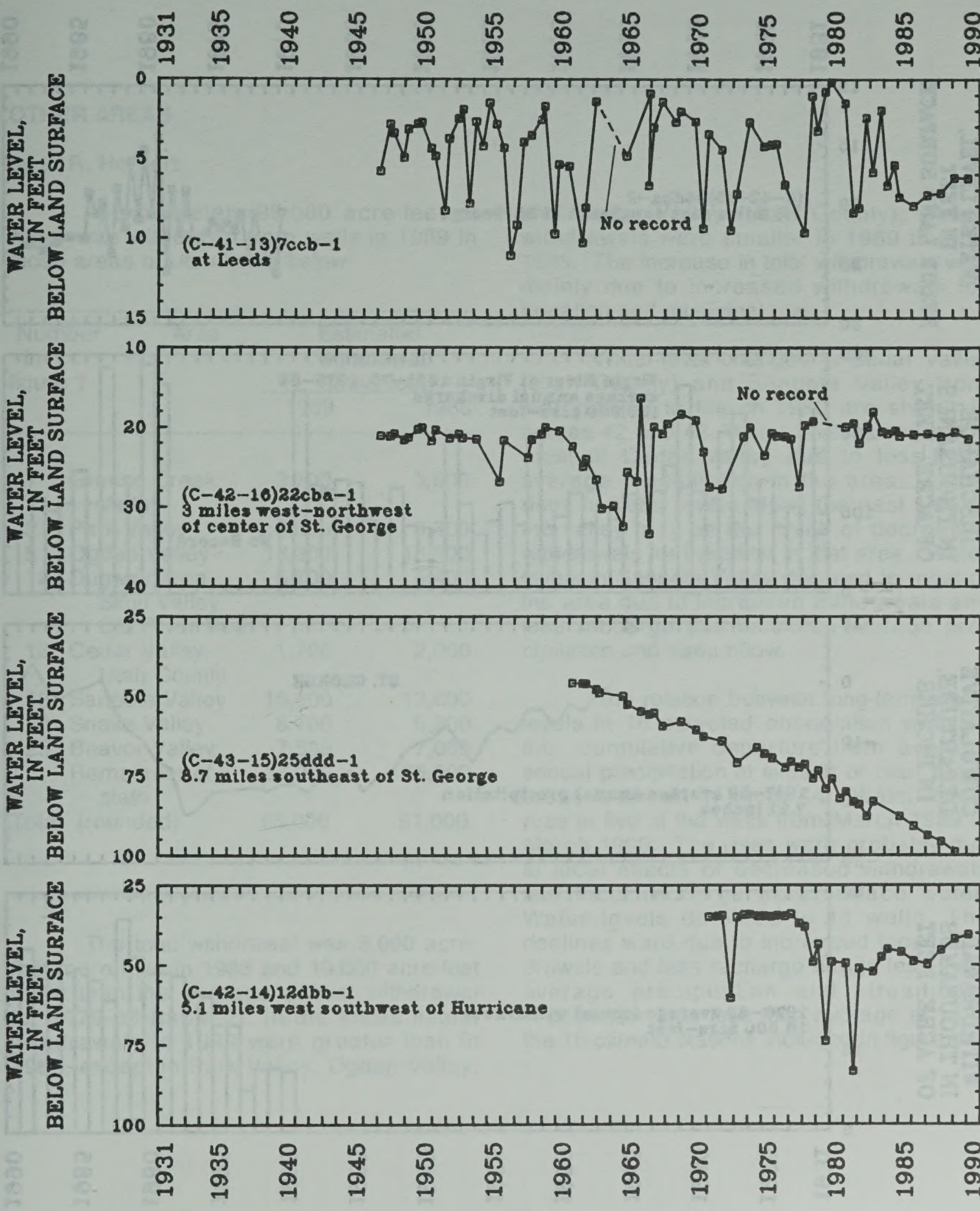


Figure 41.--Relation of water levels in selected wells to discharge of the Virgin River at Virgin, to cumulative departure from average annual precipitation at St. George, and to annual withdrawals from wells in the Central Virgin River area.

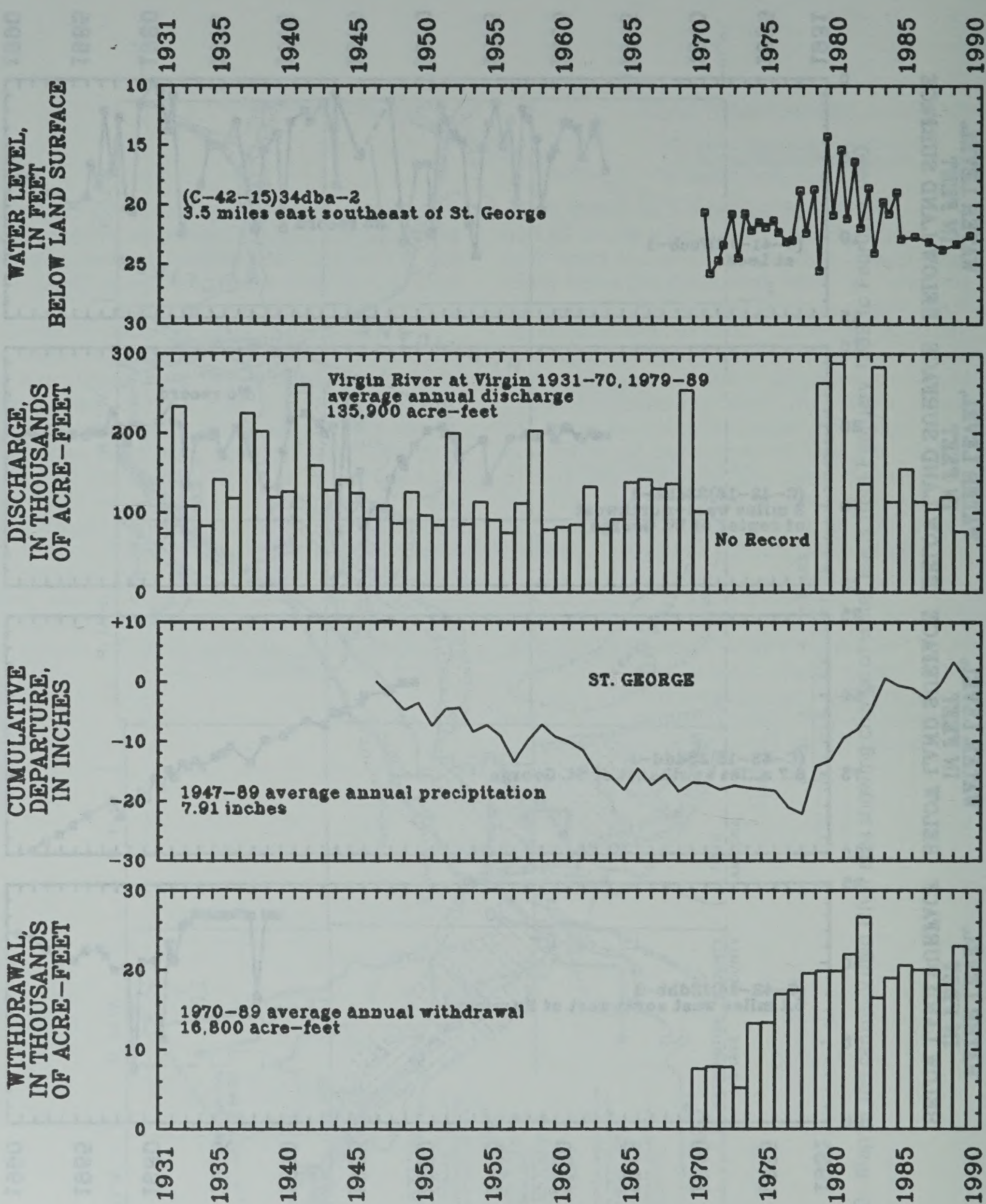


Figure 41.--Continued

OTHER AREAS

by L. R. Herbert

Approximately 96,000 acre-feet of water was withdrawn from wells in 1989 in those areas of Utah listed below:

Number in figure 1	Area	Estimated withdrawal (acre-feet) 1989	1988
1	Grouse Creek Valley	3,700	3,500
2	Park Valley	2,600	3,300
8	Ogden Valley	13,300	13,500
12	Dugway area Skull Valley Old River Bed	5,700	5,400
13	Cedar Valley, Utah County	1,700	2,000
18	Sanpete Valley	15,600	13,600
23	Snake Valley	8,700	6,200
25	Beaver Valley	7,500	7,000
	Remainder of state	37,200	36,500
Total	(rounded)	96,000	91,000

The total withdrawal was 5,000 acre-feet more than in 1988 and 19,000 acre-feet more than the average annual withdrawal for 1979-88 (table 2). In the areas listed, withdrawals in 1989 were greater than in 1988, except in Park Valley, Ogden Valley, and Cedar Valley (Utah County), where withdrawals were smaller in 1989 than in 1988. The increase in total withdrawals was mainly due to increased withdrawals for irrigation and municipal use.

Water-level changes in Cedar Valley (Utah County) and Sanpete Valley from March 1989 to March 1990 are shown in figures 42 and 43. Water levels declined in most of Cedar Valley due to less-than-average precipitation in the area. Local rises in water levels along the east side of the valley may be the result of decreased withdrawals for irrigation in that area. Water levels in Sanpete Valley declined in most of the area due to increased withdrawals and less recharge due less-than-average precipitation and streamflow.

The relation between long-term water levels in 16 selected observation wells to the cumulative departure from average annual precipitation at sites in or near those areas is shown in figure 44. Water levels rose in five of the wells from March 1989 to March 1990. The rises were probably due to local effects of decreased withdrawals and local recharge from surface water. Water levels declined in 11 wells. The declines were due to increased local withdrawals and less recharge due to less-than-average precipitation and streamflow. Precipitation was less than average at 14 of the 15 climate stations included in figure 44.

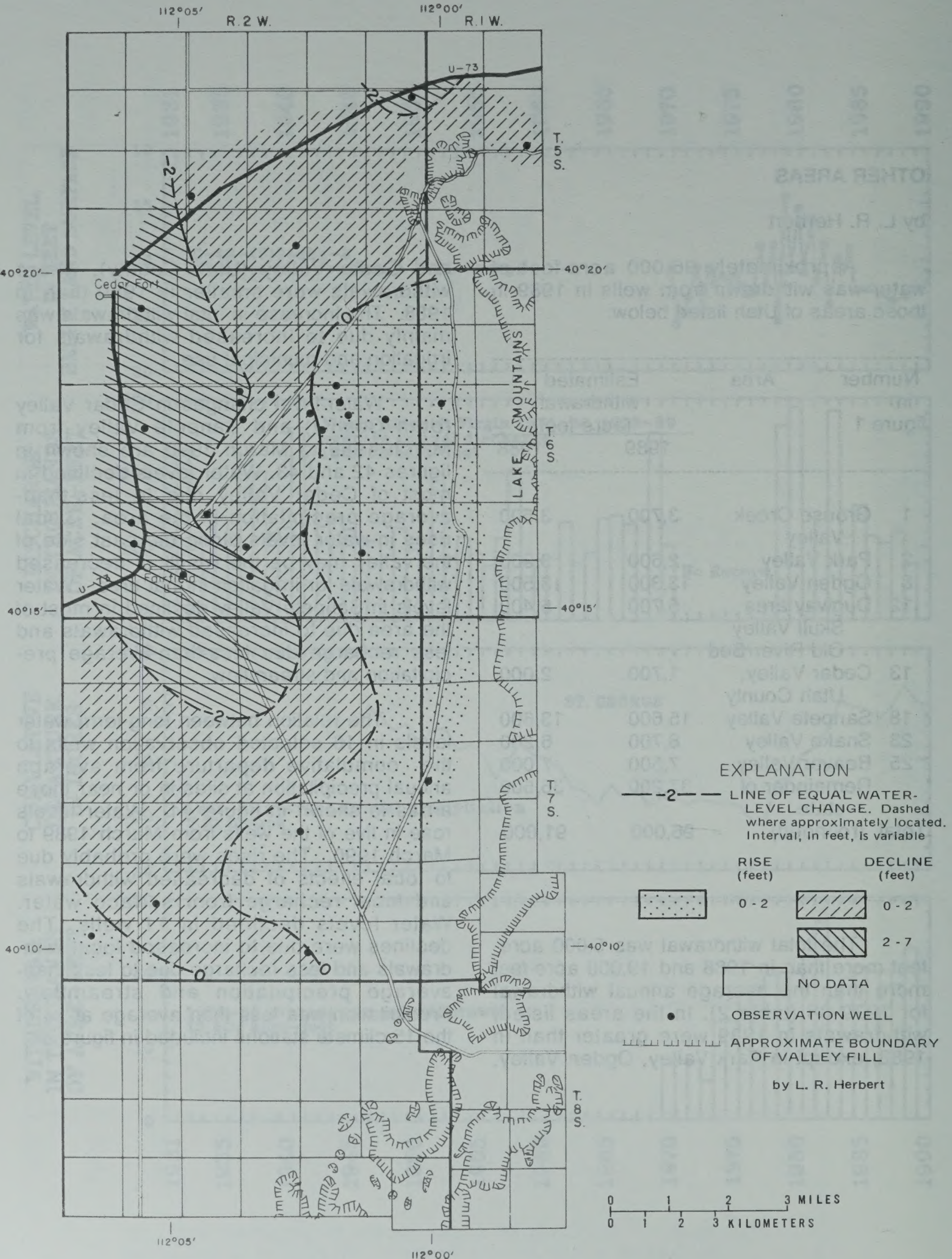


Figure 42.--Map of Cedar Valley, Utah County, showing change of water levels from March 1989 to March 1990.

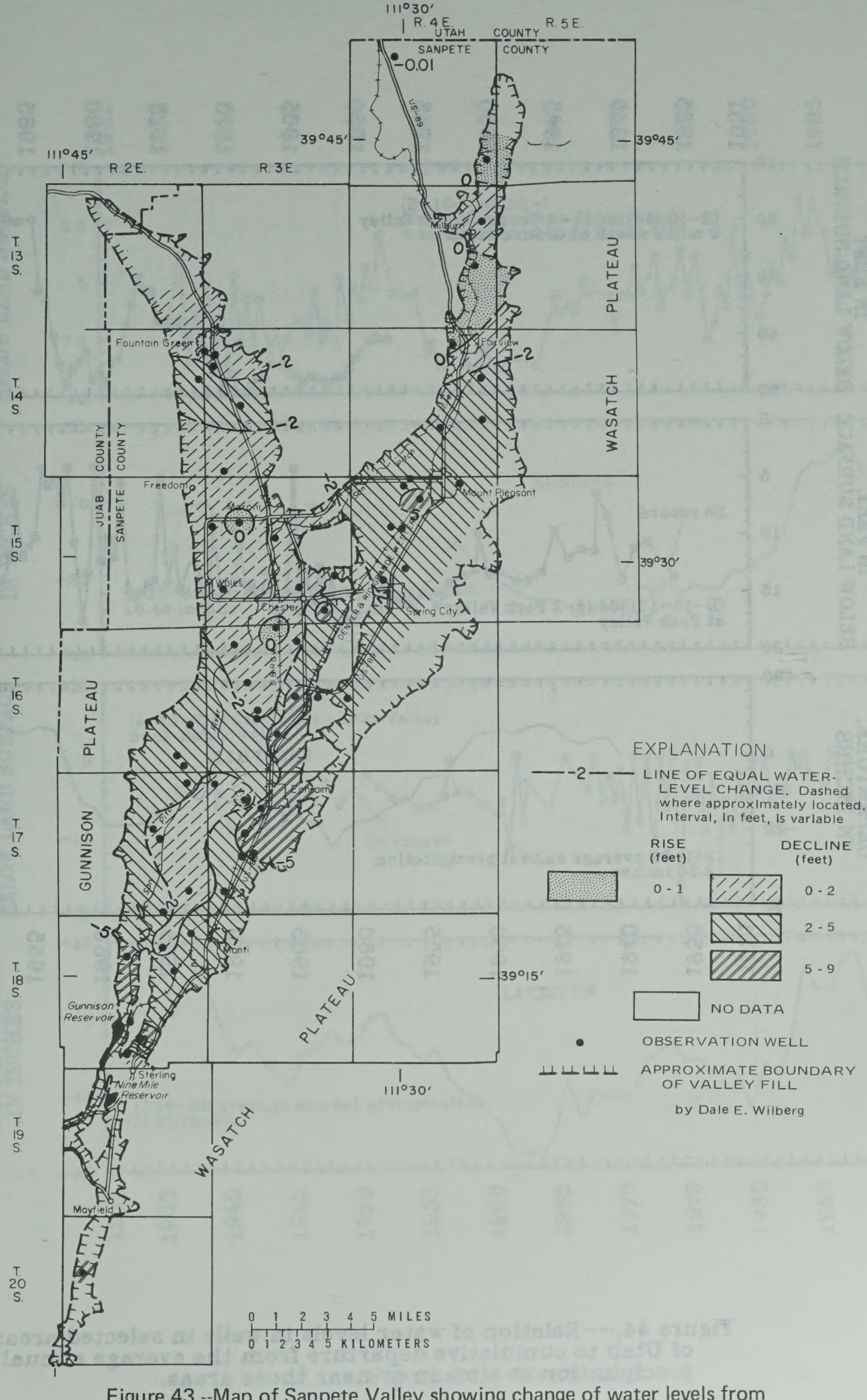


Figure 43.--Map of Sanpete Valley showing change of water levels from March 1989 to March 1990.

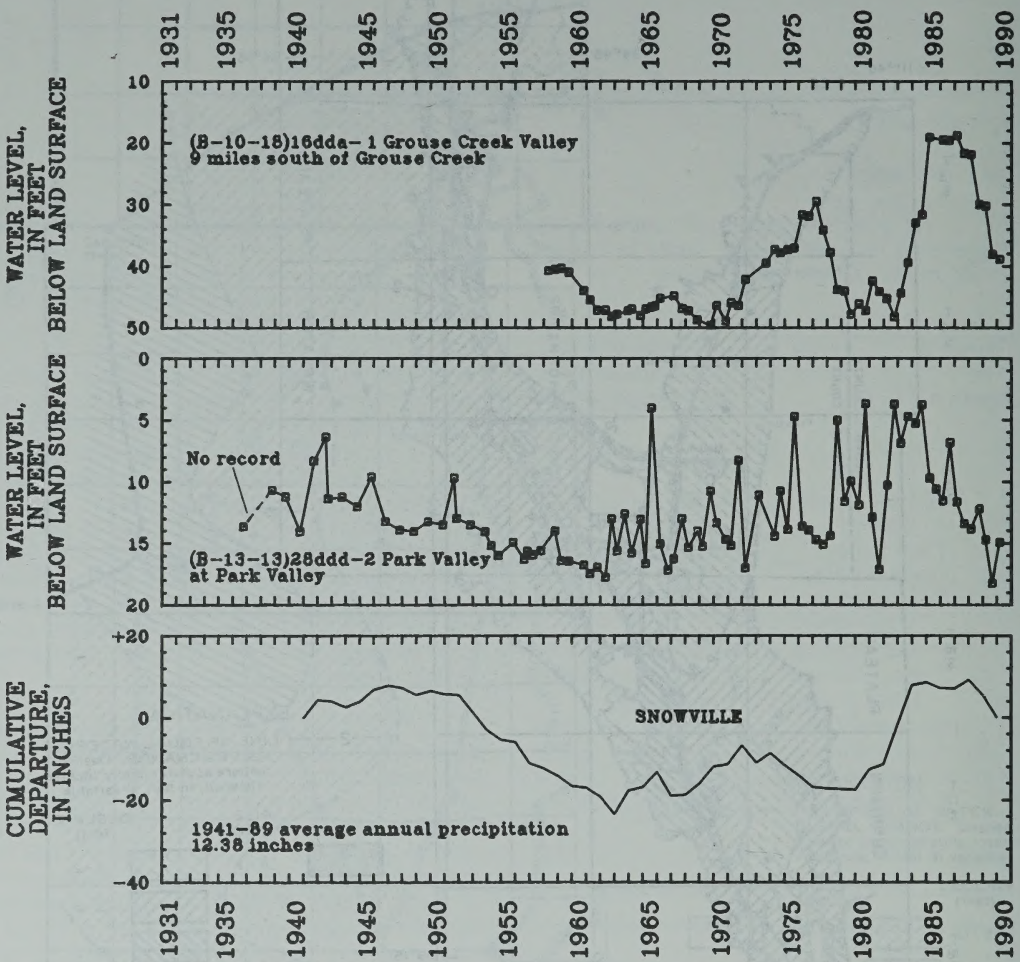


Figure 44.--Relation of water levels in wells in selected areas of Utah to cumulative departure from the average annual precipitation at sites in or near those areas.

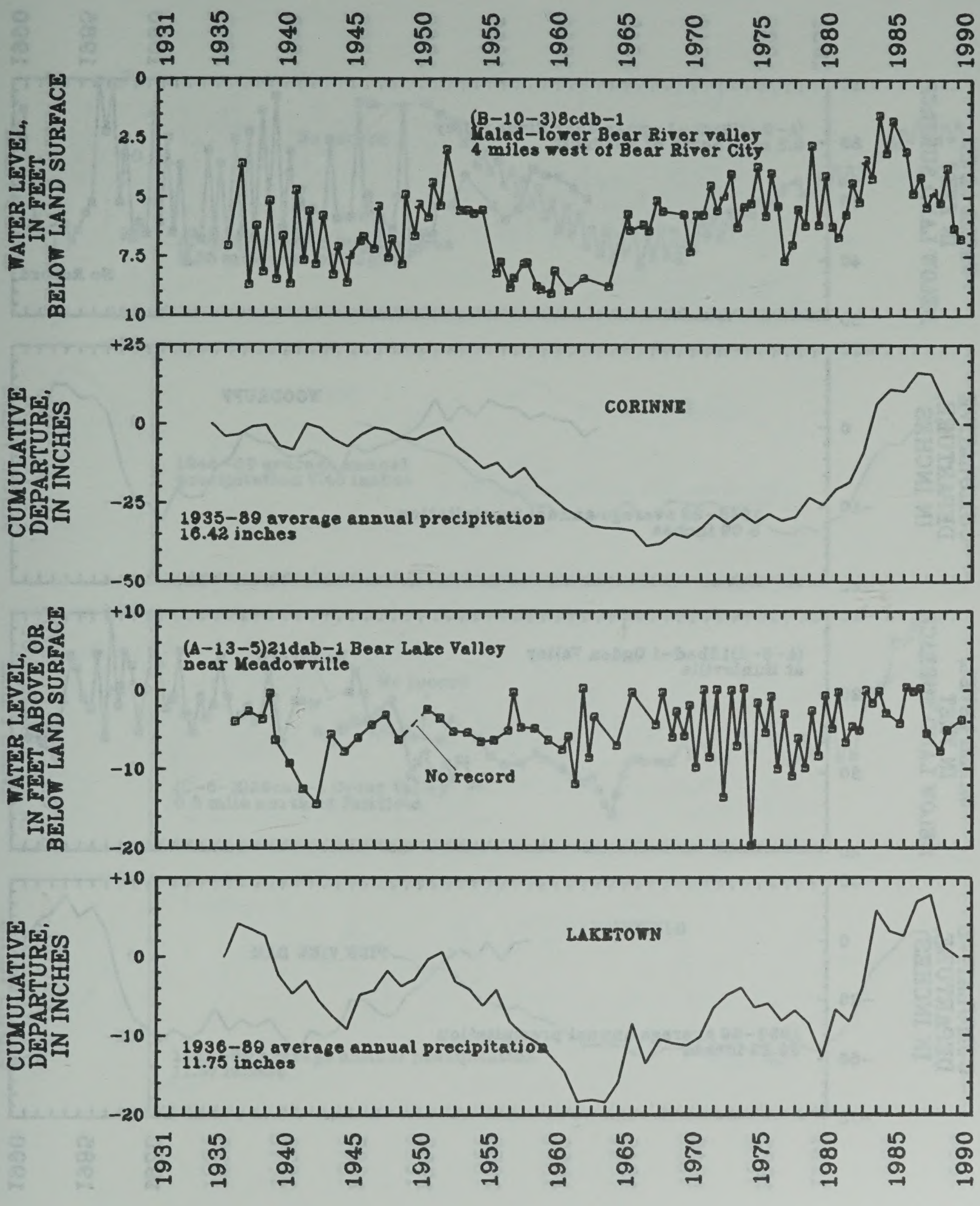


Figure 44.--Continued

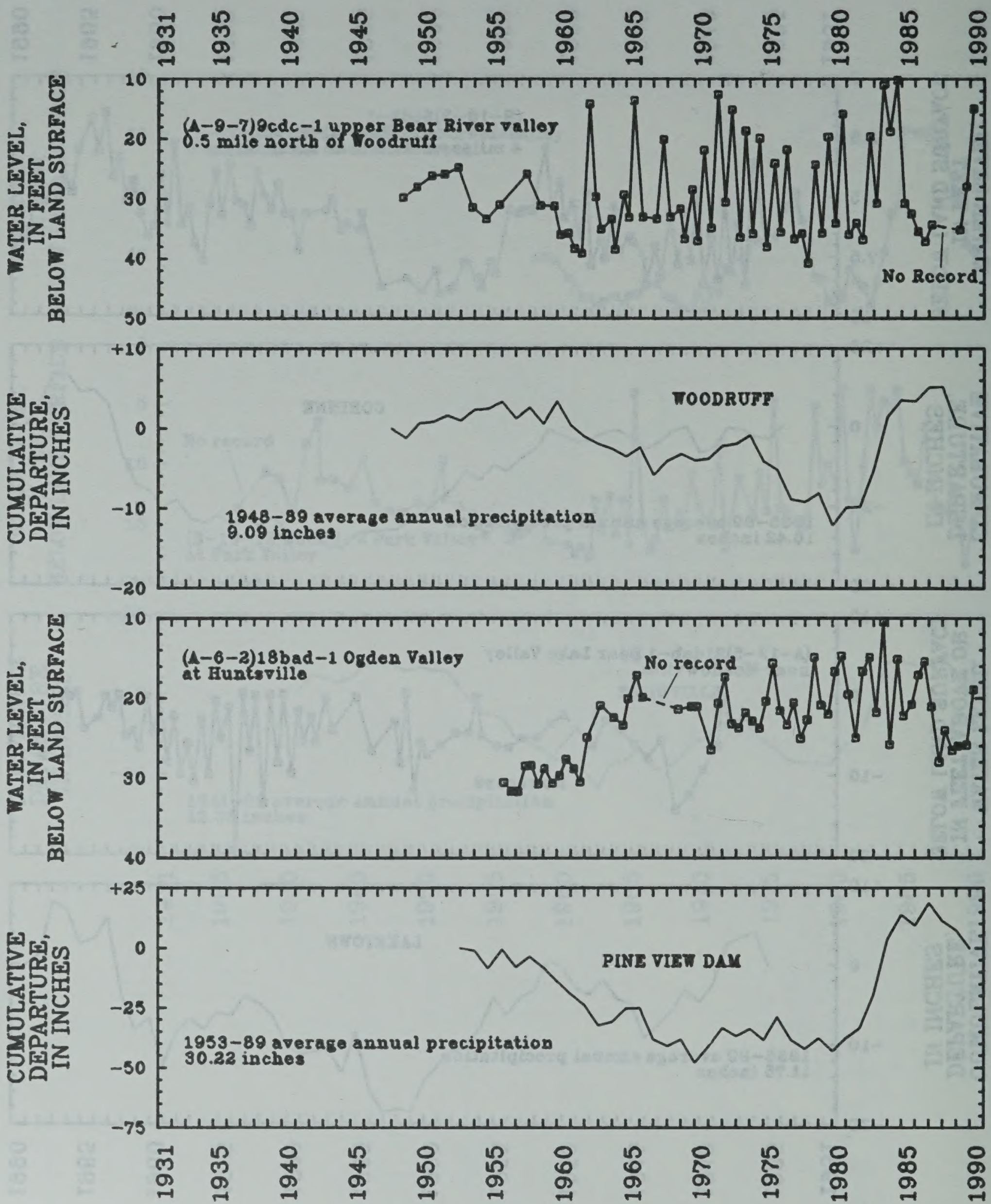


Figure 44.--Continued

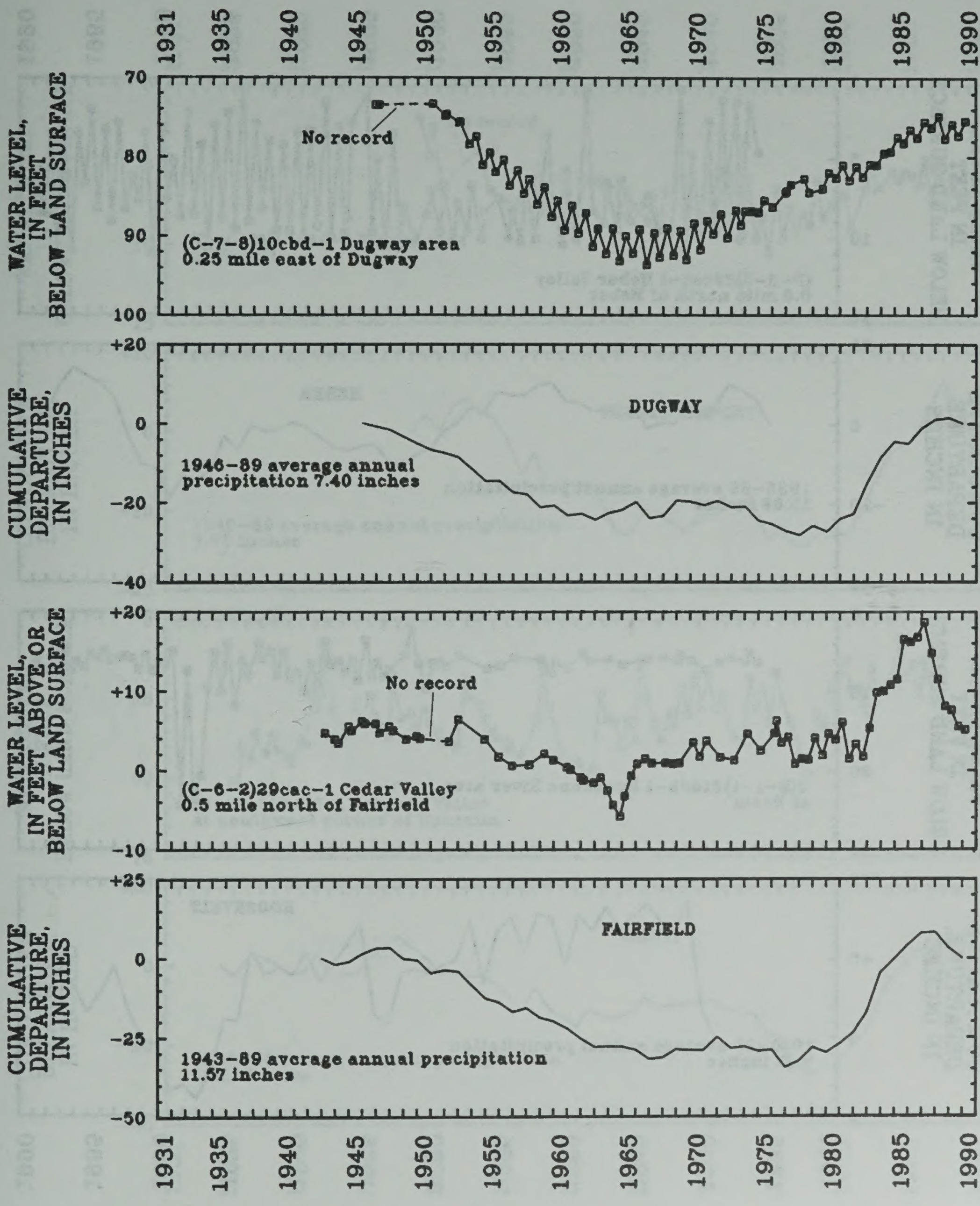


Figure 44.--Continued

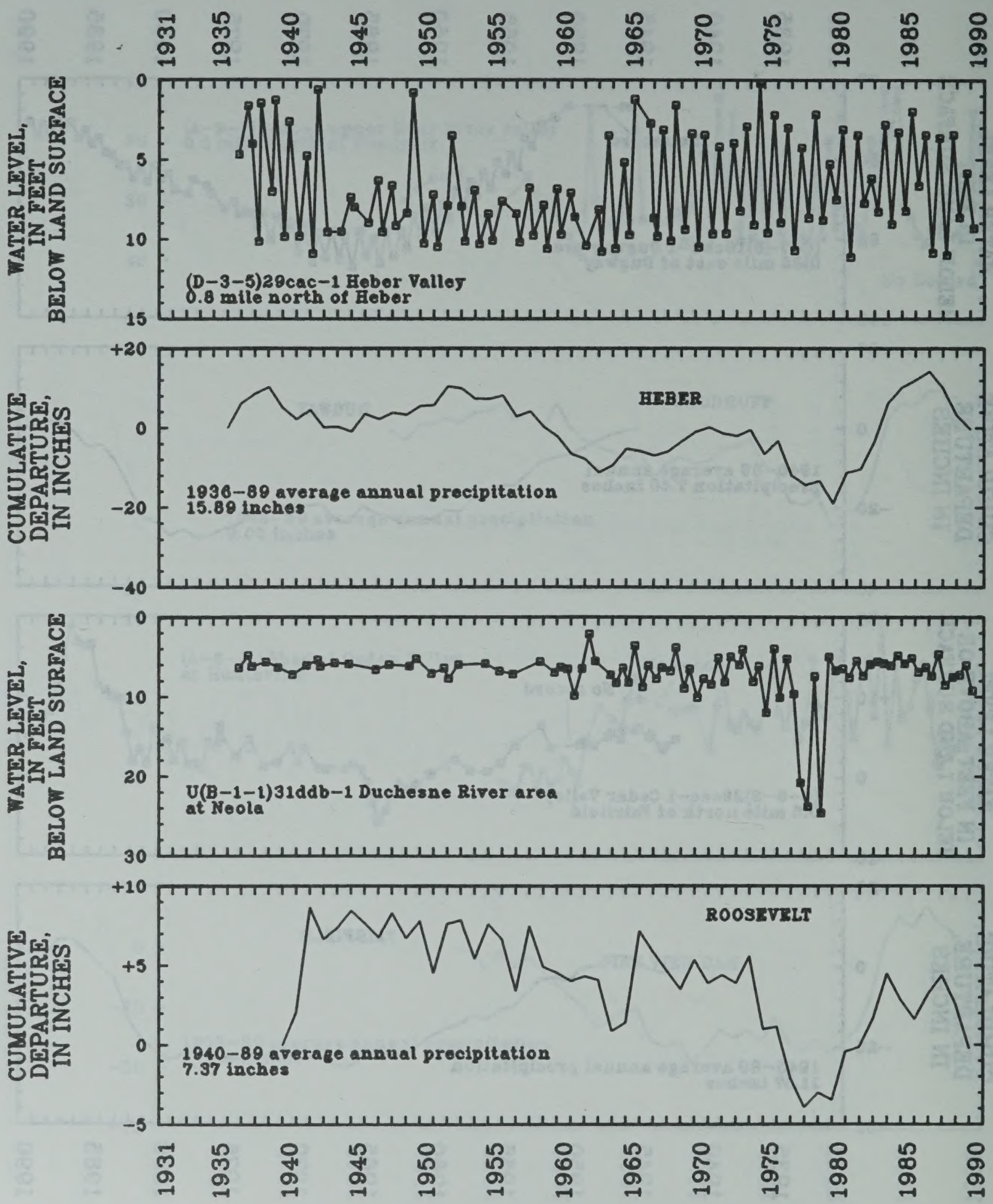


Figure 44.--Continued

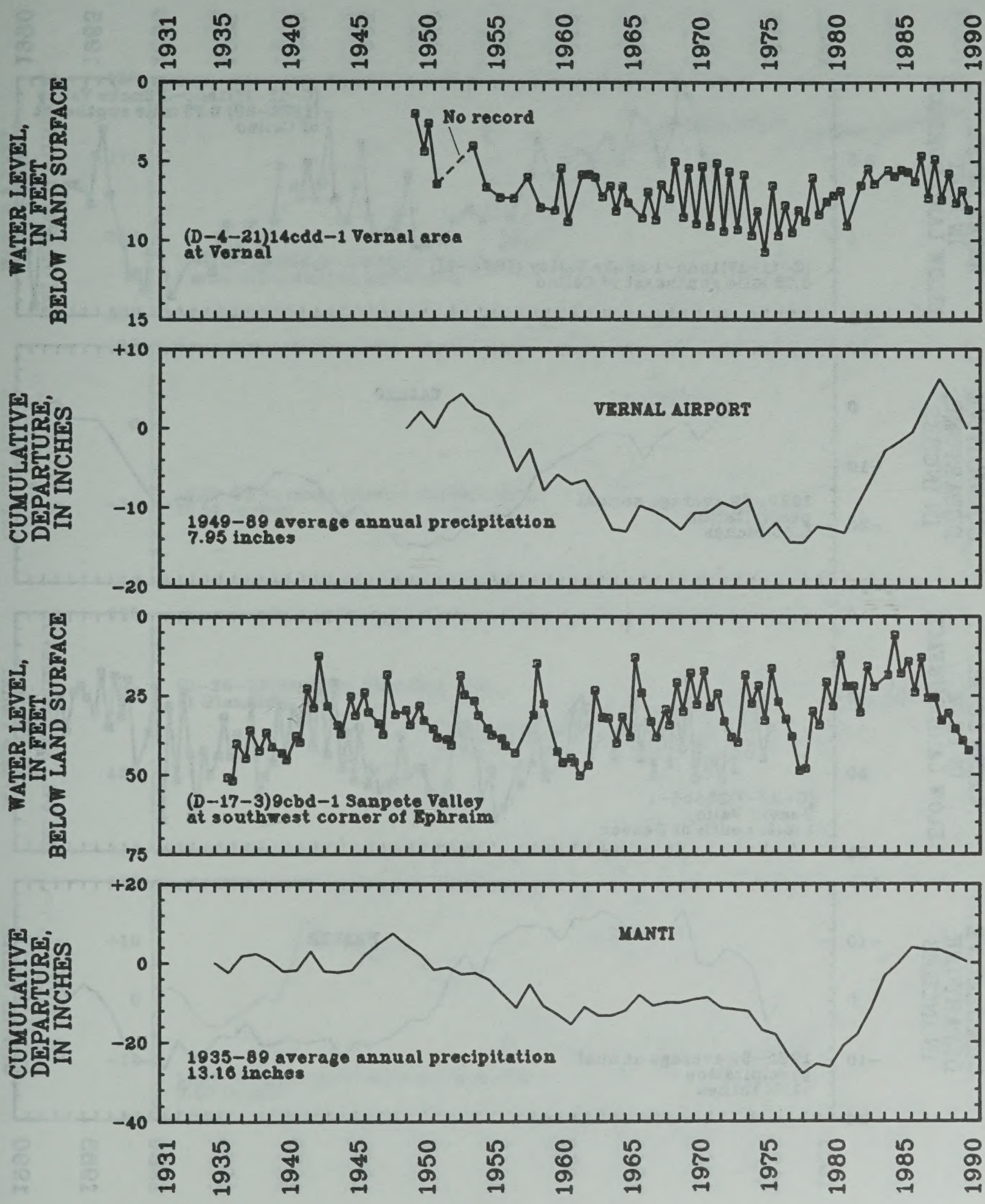
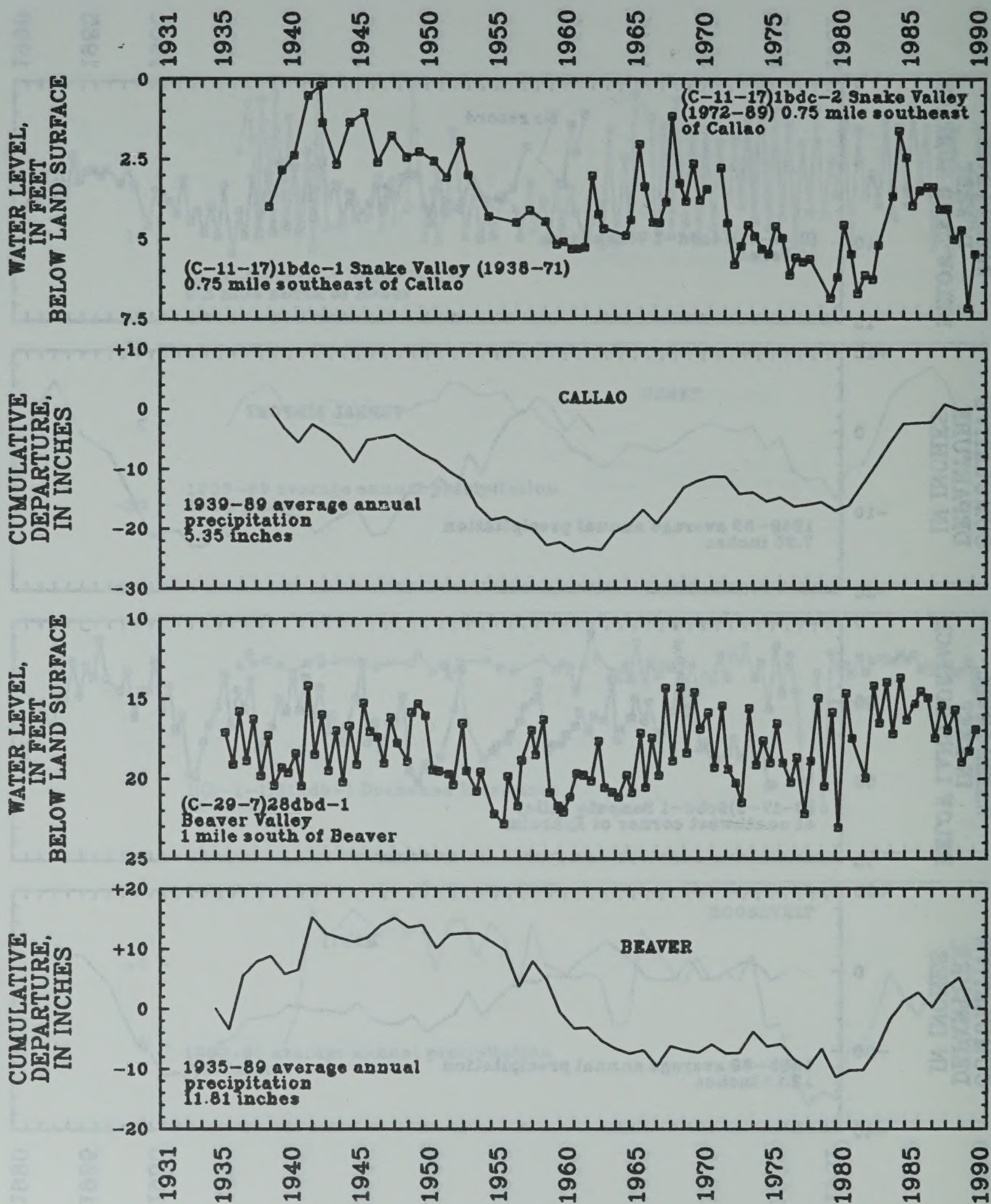


Figure 44.--Continued



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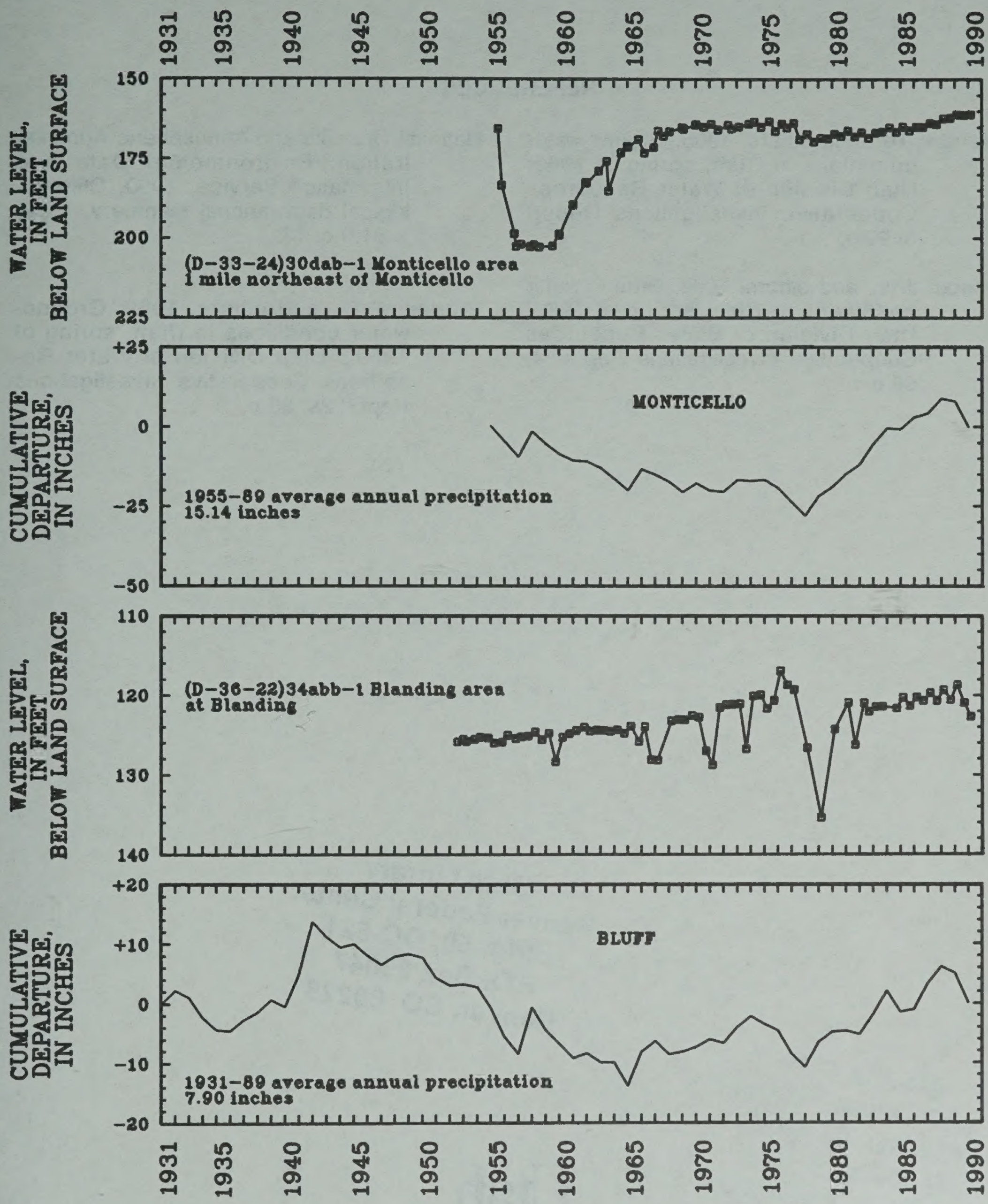

Figure 44.—Continued

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